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**THE UNIVERSITY AND
THE FUTURE OF AMERICA**



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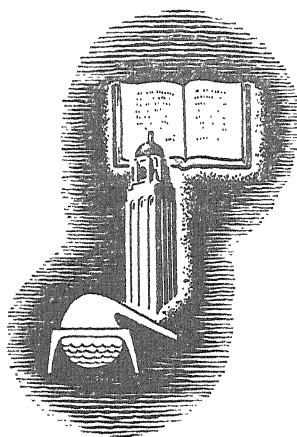
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THE UNIVERSITY AND THE FUTURE OF AMERICA



STANFORD UNIVERSITY PRESS
Stanford University, California
Humphrey Milford :: Oxford University Press
London

STANFORD UNIVERSITY PRESS
STANFORD UNIVERSITY, CALIFORNIA

LONDON: HUMPHREY MILFORD
OXFORD UNIVERSITY PRESS

THE BAKER AND TAYLOR COMPANY
55 FIFTH AVENUE, NEW YORK

THE MARUZEN COMPANY
TOKYO, OSAKA, KYOTO, SENDAI

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PRINTED AND BOUND IN THE UNITED STATES
OF AMERICA BY STANFORD UNIVERSITY PRESS

FOREWORD



FIFTY YEARS is but a time beat in the history of the human race, but it covers more than a dozen generations in the life of a university. When these fifty years happen to come in one of those fruitful periods during which civilization seems to advance with a sudden spurt into a new intensity where there is rapid growth in population and expansion of the whole environment of man from invention, scientific research, and social and economic advance, the university is profoundly affected.

Stanford University was born at the beginning of such a transition, and in its short existence has gone through depressions, wars, earthquakes, and many social changes. On the occasion of its Fiftieth Birthday it seemed worth while to bring together a group of noted scholars to present an analysis and judgment of the progress made, the paths open in the future, and the relationship of the university to the future of America.

As the pages that follow will show, it has been a thrilling experience to meet together, to see some of the experiments made possible by the cyclotron, to hear from the lips of outstanding and thoughtful Americans a brief digest of the essential and fundamental facts in those phases of our common living most closely in touch with the university, and to get from them a glimpse ahead into our future along paths that now lead right up to that zone where the unknown awaits unraveling and clarification.

Out of it all comes a clear picture of the dependability of the laws of the universe and of the secure footing gained when any one fact is established. Mystery and superstition disappear, order and reason take first place. It is surprising to see how

extensive, are the great forces running through the minds of men. These need direction in order to be useful. They need guidance to be kept under control. They need a factual basis not to run off into emotional storms. To the university comes the responsibility of training men and women and of conducting research to bring this about. The university should endeavor to lead our country so that there will open up those almost unlimited possibilities before man as a physical, intellectual, moral and spiritual being.

In commending this symposium to those who want to know what some of our most profound students think of our problems, may I, on behalf of Stanford University, thank those who came to join us in celebrating our Birthday and who showed what genuine, reliable, dependable, capable, and unselfish service can do.

RAY LYMAN WILBUR

STANFORD UNIVERSITY, CALIFORNIA
September 16, 1941

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**THE UNIVERSITY AND
THE FUTURE OF AMERICA**



The Twelve Houses of Heaven

ISAIAH BOWMAN

President of The Johns Hopkins University



CAN WE LOOK into the future? By what power, and whence derived, do we cast a modern horoscope? These questions arise because the title of this Symposium, "The University and the Future of America," implies that we possess the power of forecast. "University" itself is an ambitious word, symbol of man's comprehensive mind; while "future" has no less than divine associations. The power of forecast is now most often claimed (the Weather Bureau excepted) by astrologers who live beside the boardwalks of our play cities and interpret "dread Scorpio or Capricornus, lord of the Hesperian wave," for half the price of a watch crystal.

The ancients sought evidence of the divine intention in the heavenly bodies "wondrously linked together," God's finger writing his will "across the sky in stars." To each of the zodiacal signs they assigned a "house," and the twelve divisions of the resulting diagram were called "the twelve houses of heaven." It is my purpose to indicate a few of the means by which these twelve houses of heaven have been brought down to earth by science, by intuition, by poetic insight, and by man's driving will, directed along the paths of curiosity and necessity. We may then venture to consider some aspects of our fate and our power to alter it by the forces at our command, including a modern university. The houses are indeed incomplete at the moment, and a few are still locked; but we are confident that elements

of human destiny are in all of them and that the day will come when their benign secrets will be revealed. There need be no loss of a sense of divinity in the process. The ultimate mysteries of Creation, Will, and Purpose remain, and Science cannot drive them out of a universe in which each of us is but the merest atom of sentient being confined momentarily in borrowed earth.

To some, heaven is the absence of extreme heat or extreme cold; to others it is the absence of hunger, or sorrow, or night bombing. The heaven I am dealing with is a state of social mind that tries to do something about the future, and looks around for means to ameliorate unnecessary hardship and to foretell a wise course of community action. While a forecast of the results of the struggle of good *vs.* evil is in many sectors of human experience a scientific problem, more fundamentally it has become in our day a social problem. Science is manageable and swift in development largely because it is impersonal: atoms do not care. Social objectives, on the other hand, are the expression of a people's will—at times their vagrant or impulsive or irresponsible will—when each man is thinking of his own good and only a few are thinking of the general good.

The human *will* is deep-rooted on the biologic side and has an instinctive quality. Even the lowly Paramecium displays a will and the power to accept or reject, within a narrow but at least recognizable range. The quality runs up through the animal kingdom and reaches the stage of advanced development and conscious recognition and stimulation in man. The human will is the comet in our social universe, cutting across the regular orbits of man's rational behavior. For example, science is not the cause of war. What man wills to have or to do is the cause of war. Science and invention provide tools, scientific discovery identifies natural causes, the mind devises or discovers rationalities—all of which may be betrayed in pur-

pose by a mistaken belief or a mistaken social will, even in a democracy.

Belief and will must therefore be challenged, in a democracy as elsewhere, if we desire a happier future for mankind. Science cannot formulate the whole of the challenge. An analysis of social choices plays its part in the formulation. *How do we want to live?* That is the great question, antecedent to all others. Once answered, science can tell us in a rather high degree whether or not a desired way is attainable. Science can forecast some of the results if a given way be followed. Intuition and imagination also play a role, for by them in part we form *a judgment on what men can do, or will do, or may be persuaded to do*. It is clear that we do not inhabit the houses of our social heaven except after hard work upon complex scientific and social processes. It no longer suffices to read a book of incantations if we would "unfix the stars and bring them down" to earth. The choice of method of work upon social processes presents an immense intellectual challenge.

We may focus in the first instance on food, the most elementary requirement of society. It is the primary concern of most of the world's population. It comes before freedom, for no man is free who is not free to eat. Martyrs excepted, men will trade all other freedoms for it. Unless minimum food requirements are met, there can be no advanced cultural creations. The first social purpose is that no one who is willing to work shall suffer hunger in a land where there is, or can be, an abundance of food. If there is scarcity, the rule adopted by the Pilgrim fathers in 1621 can hardly be improved: "So they were presently put to half allowance, *one as well as an other*." The period of shortage ended, a less communal system than the one first adopted was needed to spur food production, each man planting corn "for his owne particuler." Thus they got "farr better contente." The social will required the spur of private enter-

prise as an alternative to confusion and discontent and the shirking of depersonalized tasks that were the consequences of a communal system. Social tone and standards were lowered when each man determined to do no more than his neighbor in the production of "the goods of the generall." There is no obligation to feed a lazy man, whether we think of 1621 or 1941. There is an obligation to keep alive the capacity for enterprise through which each earns his share: i.e., to devise opportunity, to provide work that gives dignified access to food.

Social will now has its most insistent and general expression in the public thought of America with respect to the standard of living and in social action designed to raise it. This is the meaning of the irrepressible conflict over the division of the national income. It has come to be the true meaning of party platforms. Thirty-five years ago the party platforms and the messages of the President of the United States dealt emphatically with tariff, trade, natural resources, conservation. Today they deal with relief, youth opportunities, debt, standard of living. We have turned from our original heritage of land to the social use of the things inherited, discovered, and developed or made: soil conservation, not land acreage only; patent rights and applications in relation to industrial power and its social use, rather than patent protection merely; products and profits of major industries; and so on.

"Young people want so much more today because there is so much more to want," phrases a social problem of our time. Science has played its part in the implied disturbance. To see a motor car is to desire to have one: "Why do I walk while others ride?" No less personal and insistent in their operation are the forces that drive a society to think about access to the securities of good health, ability to purchase the physical conveniences of life, participation in the joys as well as the concrete social gains of recreation. Social demands have been increased

by internal mobility of population and by the rapidly increasing demand for differentiated industrial labor in the cities during the past twenty years, following the sudden and heavy reduction of European immigration imposed by the immigration laws of 1921 and 1924. Our explorations and enterprise have shifted from land and sea to people—human *desires* and not merely minimum *needs*. Standard of living is now an all-inclusive phrase. Belief, emotion, and sheer desire make it a driving national force.

Scientific conclusions are displaced by political assertions, or twisted out of context by those who clamor for a theoretical standard without looking at consequences that may destroy the possibility of raising standards at all. In the modern heaven, asphalt streets filled with motor cars take the place of gold paving; a radio in every room replaces a harp in every hand; paradise means free health care, old-age security, unemployment insurance, recreation organized by government, in short, comfort, security, and amusement—all completely desirable and attainable if we can keep the principle of earning, of reaping where one has sown the seed of enterprise.

Since all of these things come back to total national income based on production and a rational price structure, and since production depends in part upon what we do with our natural resources, I shall narrow the remaining discussion to certain social and scientific aspects of conservation. In the scientific field there is a natural division between individual technical studies and comprehensive social-program studies. I would fail of my purpose in discussing the usefulness of the university in the future of America if I omitted the meaning of program. For a time the cult of impersonal and nonutilitarian science gave program an unorthodox and shallow connotation. One left program to the politicians. One prided oneself on the disinterestedness of one's science. The present war, atop of our recent

social strains, has reduced if not banished this self-justifying preciosity. When our entire system of living is at stake, when the land itself cries out against us and "the furrows thereof likewise complain," it is time to harness science to humanity in a social program, to identify evil and proclaim its shapes and acts, and to give heed first to that general good that provides a frame of opportunity for the individual good.

Such national co-ordination of our work for the general good requires a new grasp of essentials, indeed a quite new statement of essentials in our technical and scientific studies. Technical excellence is still a real objective. One must sink deep wells and only an expert can do so. Details matter. In scientific work, precision is important, and a precise notology is indispensable. But always the mind must drive toward *co-ordination*. What does the design mean socially when the pieces are put together? For whom, and for what purpose are we putting the pieces together? The pieces are now so numerous and so complex in construction that training in *assembly* is more important than the creation of new parts. Departmentalization in our universities is a natural result of orderly technical progression in complex scientific studies. To some degree we require it still and shall long require it. When it comes to *meanings*, however, it will be a detriment if overdone. In any event, the university of the future must actively address itself to the statesmanship of its work, to the vigorous attack upon vital social questions and the clear statement of social meanings. "The true business of a University is to train liberty into responsibility, to teach a young man to think for himself yet so as he remembers he is a citizen" (Sir Arthur Quiller-Couch). The narrow specialist of today is not even a good specialist.

Unless we have a sense of social direction developed in our training programs, our Ship of State will be in the position of the Bellman in the *Hunting of the Snark*. According to the

preface of that social masterpiece the bowsprit of the ship in which the hunt was made was unshipped once or twice a week to be revarnished; but when it came time to return it to its place no one on board could remember to which end of the ship it belonged. The Naval Code had no reference to it. Worse still, rule 42 of the Code required that no one should speak to the helmsman, and the helmsman should speak to no one. So steering was abandoned until next varnishing day, and in the interval the ship usually sailed backward!

The first responsibility of the University is to do its part in answering the gravest of all social questions: *At which end of the ship shall we place the bowsprit?* That is, shall we go forward or backward? Going forward means that we search for the *causes* of undesirable social conditions. This requires us to *do* and not merely discover and *deplore*. When nation-wide defects of economy are joined to nation-wide effects of an unbalanced natural environment, we call to our aid two forces: science and general control for the general good rather than individual control for the individual good. What is science for if not to meet such a situation? What is government for if not to make science applicable to regional difficulty and general economic difficulty? The Corn Laws of ancient Rome, like the Corn Laws of nineteenth-century England, were government in action on a problem too large for the individual. When mobs begin to march, central authority is put to the crucial test of action. Only government can deal with clamorous crowds, because government means, first and always, law and order. When public order goes it is because government has already gone.

If the Ship of State is to sail forward and not backward, government must give effect to scientific findings and the social will. Often this means that it must "evoke new power," to use Bagehot's phrase. It must *lead*. In a simpler economy there could be less government. As complexities grow, only govern-

ment can put the pieces together, for only government can create and command the statistical data required by regional diversity, complexity, and imbalance, or implement the national studies that help resolve conflicts between regional purposes. This involves as profound a change in America as the much-discussed economic changes. No conservation program is possible that leaves objectives, rules, penalties, and limits and kinds of resource-use to the individual. "Free enterprise" is never free in a society of striving, spirited men. Enterprise, yes, but enterprise within an ascertained, prescribed, and majority-controlled "general good." We see this well illustrated in the erosion-control districts of the Soil Conservation Service. Freedom, in that field, consists in the ascertained truth that destruction follows upon non-co-operation. Enterprise consists in co-operation with neighbors under rules designed to save the soil, which is one source of the common good.

In taking stock of our resources we shall fail if we think that they alone will make us great. Nor will our economic and social structure make us great. It is an accepted commonplace, I hope, that wealth will not make us great. We certainly cannot wish or hope ourselves great. We can be great only through the high quality of science and spirit applied to our social and national problems. When Lincoln in 1861 referred to "that form and substance of government" to which he said we were committed and intent upon preserving, he referred not to the text of the Declaration of Independence or of the Constitution but to a living force in the people. He asked, in effect, how have we chosen to live? He answered, "by giving every man a fair chance in the race of life"; that to him is what freedom meant. Freedom or bondage are words that imply, nay, demand, now as then, a social and national *choice* of objective. Hunger is a social and national choice if hunger persists, for we can produce plenty. Bad health is a social choice, if bad health persists, for

we have the science and the training that will improve health. The American people long ago made its choice in the field of education. Over *two per cent of the national income* is spent on the schools. In our cities this corresponds to one-fourth to one-third of the annual local tax dollar.

Economic conditions force limitations upon all these social choices. Who is to pay for it, and how, is as important as social choice. When we strike a balance between them, the moment of decision has come. Basic to the process of striking a balance is our natural-resource inventory. That inventory itself is determined by our knowledge and by all of our knowledge, scientific, technical, statistical, exploratory, social. Then come criteria of appraisal, added to insight, added to history or how we came up from a simple to a complex society, how we started, what we have had in view, how we changed, how we got to this point on the road of national development, who we are, what we do, and where we live, expressed in concrete terms, region by region.

That we are *here in America* is our great predestination. Our productive system is based upon the forms and processes of our society in *this* land of America, not any land, an America that extends "from sea to shining sea," a land of inspiring breadth and opportunity. It is a land that has bred statesmen of heroic magnitude of mind who looked forward into the to-morrows of our national destiny, and who call to us today to let our actions rise to the level of the obligations of our democratic power in a world gone mad under the rule of individual power. We can search for and attract wealth from overseas only if the sea remains free. We can draw out of our land, in intelligent co-operation with natural laws, a bounteous living for all only if all remain free, which means freedom to share opportunity, as Lincoln expressed it. That opportunity is limited in part by our geographic base and what it can do for the productive

processes to which our society is or can be adapted. Throughout our history runs the golden thread of opportunity in a land of great natural wealth, whatever our system of culture. Now, in 1941, we find ourselves obliged to create new opportunity by looking critically at our systems of land-use, at our productive system, and at our social choices in the field of nutrition, health, recreation; and by recognizing the limits of economic ability to support desirable ends that may be unobtainable at the moment.

We make a fundamental mistake if we suppose that we have either conquered nature or come to the end of our knowledge about her. An equally fundamental mistake is that of supposing that we are ready for a completely rational society. Our instinctive bodies still seem to take care of themselves better than our tutored minds. The exercise of the popular franchise records feeling and "common sense" chiefly. It is not the record of a fully informed choice. It is statistical grouping of desires, class-conscious choices, prejudice, and rationality. It is not necessarily wise or rational because it is democratic.

The role of the university in the future of conservation is that of interpreter of (for the most part) governmentally derived statistics. Aside from training services it has two chief interpretative tasks: to discover or determine the laws of waste, and to identify the border zones as well as the central areas of maladjustment of use to longevity of resource. Our observational data are abundant, but interpretation lags far behind, and good administration is most laggard of all. Every region where depleted crop yields result from lowered soil fertility should be the object of special and immediate critical study whether or not the crop is in a state of overproduction. The basic cause of alarm is depletion of fertility, not crop. It can not be over-emphasized that there is no such thing in the world as excess of soil or soil fertility.

The causes of soil change are long-term if not permanent, while crop changes may be transient. It is *law* that we seek to discover in university research and it is basic truth that we aim to teach. Every scholar is a trustee of accumulated wealth of knowledge and of an attitude, fostered through the ages by relatively few, that a knowledge of the truth is beneficial in the long run. With no confidence whatever in the value of numbered "laws," I venture to set down nine ascertained laws of conservation as specific examples. It is to categories such as these that the university of the future should give, in my opinion, far greater attention. They illustrate the character of studies that combine a social critique and a scientific critique. I believe that they may help provide social orientation. When to them are added historical example, they show that man can actually do something *in time* about his fate. They are the basis of a *modern form of foretelling*. I submit the following specifications for a few of the twelve houses of heaven, *in the form of ascertained laws or principles of conservation*:

1. There are natural laws controlling the organization of the earth's surface and the adaptation of soil mantle and vegetational cover to surface degradation. When the natural laws are identified and understood we may still be far from controlling the soil-erosional effects under specific forms of land use. But by determining a given cause-and-effect relation we have at least come nearer the possibility of controlling or mitigating evil effects.

The *science* of conservation is the determination of cause or, if cause be unknown, the accurate determination of the rule-of-phase or process. Social control of destruction—for example, a co-operative forest-fire-fighting unit—becomes more intelligent, more general, more loyalty-evoking, as fundamental causes or processes are more widely understood.

2. The second principle of conservation is that we must deal with a natural resource on the spot, acre by acre. This means, in soil conservation, that we must cultivate slope land on the contour, adopt the practice of strip farming if necessary, defend the land against gullyng, hold the soil in place field by field. Minerals, forests, waters are like soils in one respect—that the general survey and the general measure never exempts a man on the spot from the duty of avoiding needless waste. The immediate user is never exempt from his local responsibility.

It is tested and proved folk experience that it is necessary to retain soil and water on the spot to as high a degree as the limits of labor and crop value permit. A thin soil, steep topographic gradients, concentrated seasonal rainfall, an agricultural economy based upon the culture of domesticated plants combine to offer alternatives of swift soil destruction or, alternatively, continuing soil use through conservation by terracing and other restraints.

3. The third principle of conservation is that expert study can provide a scientific basis for sound social control. The individual farm or ranch is often laid out without logical relation to the natural hydrographic unit, the local watershed; and since the natural hydrographic unit has had a natural growth history, since it is at an ascertainable stage of evolution, since it is fitted for a limited range of cultivation, and has a limited endowment of fertility and a distinctive regional type of water-supply and run-off, *expert* study is required if we would make a rational regional application of ascertained physical laws of waste.
4. The fourth principle of conservation is that there is no national excess of any natural resource. As a nation we expect to last into the far distant future. But even on a short-term basis we are not wise enough to see how soon an excess may

disappear. We are constantly rediscovering the earth and we can never say of any given resource that we have too much of it for the future.

5. The fifth principle of conservation is that risk is not evenly distributable. Risk is fundamental to all types of use of the earth's resources; and the degrees and kinds of risk vary. To determine the nature of a risk is a scientific task. For example, the incidence of hail is determinable for a given period of observation, the areas of probable hail can be delimited, but the value and cost of hail insurance is an actuarial problem.

Again, price variations introduce an element of risk as important as rainfall variations. A severe drop in prices may be as disastrous as a drought. Even average rainfall for a year may have little meaning because certain crops (wheat and corn) depend upon adequate rainfall at critical stages of growth in the plant cycle. Isarithmic maps showing the frequency of *critical* conditions are generally more important than maps showing average conditions. Even desertic conditions raise problems of critical import because grazing use runs from large carrying power to none at all, the rains of the driest years sustaining only a part of the plant cycle. It is the marginal lands that offer the greatest challenge to science because settlement is attracted in wet years and denied in dry years. Wide variations of agricultural surplus result. The Great Plains are climatic-risk area *number one*. In them, degeneration of soil and plant cover is the harder to offset because good years are not frequent enough or in long enough series to enable the grass cover to catch up.

6. The sixth principle of conservation is that only education will make a man feel that he is "the author of the law which he obeys." Since control by majority is required to satisfy our democratic forms, ceaseless education and intelligent and

resourceful political leadership are required to bring economic units and hydrographic units into harmonious relations. Thus is government by science brought into working relation to government by law and agreement within the law. Education is avowedly short-term. It does immediately some things that it would take generations or millennia to do by breeding. It is superficial in that the knowledge gained by education may be greater than the morality that is gained. No one can say that the education of any single individual will improve him. But in general there is improvement of a sufficient number to justify the cost. The best use of natural resources could not be attained in an illiterate society.

7. The seventh principle of conservation is that our civilization will decline unless we improve our human breed. To support the genetically unfit and also allow them to breed is to degrade our society. Definitions of terms and standards are required.

A determining factor in the social and economic life of the future is our present policy with respect to children. They are expensive possessions; they diminish the economic security of the family while enhancing its solidarity; and their progressive diminution increases social tensions. A policy of continuous examination of population structure should be adopted. Our past as well as our present and future is in that structure and in the alterations due to our population policy. Structure, not numbers merely, is of crucial importance in foretelling the population future. The population trend is not a single biological result: it has social as well as biological limits and possibilities. Wage differentials, access to conveniences and pleasures, group organizations, and industrial growth have favored the city where declining birth and fertility rates prevail. Urbanization provides a more elastic scheme of occupation for larger numbers of persons.

How we use up our country-to-city migrants is at least as basic as how we use up our soils and minerals. A human biology is needed that will not stop within the safe descriptive terms of statistical averages. It is policy that must emerge. A sound policy is one based, if possible, on a cause-and-effect relation. We must then attack the cause of an undesirable effect. A university policy that bears on future improvement of the race will not fail to be of intense concern, for the kind of people we are, biologically as well as socially and economically, is fundamental to the achievement of a higher plane of future living.

8. The eighth principle is the need for the conservation and enrichment of our culture. I once asked a Latin-American acquaintance for a definition of "culture," and here is his reply verbatim: "A sense of your place and time and of the essential manhood of the people around you and of the relations of men to men and to their place and time."

One notes that he said nothing about "tools" and "science," but since without them our modern sense of place and time would be impossible they are implicit in his answer. In a recent issue of *Science*, reference is made to a saying that the stage of civilization in every era of history has been limited by the tools at man's disposal. The saying is too narrowly conceived. Tools and enduring structures and other objects go together, of course. But the structures *as conceived* were the outcome of something already existing in the way of organization, social purpose, and political control or authority. Who laid the plans, gave the orders, told the workers what to do? One could with more justice define civilization today as an operating system of statistical services whose progenitors are found in the Old Babylonian Kingdom. In our complex civilization, statistics about the tools are almost as important as the tools!

At the moment, culture is undergoing strain through falsehood, distortion, neglect, attack. War is a hard and practical thing. It provides the framework, in many periods of history, for a culture that follows it. Liberties have been won and kept by it. It has not been all loss: "The bee fertilizes the flower that it robs." Its wastes and barbarities condemn it as a free choice: its cost is chiseled out of our standard of living, which includes our cultural standard.

- The lift which the spirit receives in the presence of artistic work of superlative quality is a thing to be conserved no less than security and economic opportunity and what Lincoln called "a fair chance in the race of life." The university of the future will conserve and elevate this indispensable value.
9. The ninth principle of conservation is that national spirit is a thing that may be lost by neglect or gained by the conscious effort of the intelligence. Within the circle of our common resolution there must be an informed, animated, and determined spirit. It is said that "He who has power over the human heart has power over great events." If we think first of Churchill we must not overlook Hitler, who has learned that lesson too and perfected a technique of devilish ingenuity. He has learned to pull down the very citadel of the human soul. To feel deep emotions, to be selfish, to doubt, to surrender and obey: these are sure steps in the evolution of a lost people led by a fanatic.

How shall we harness emotion? The university of the future must teach a transcendent faith in truth. In the name of liberty it has let the truth be corroded by those who would prefer to have the house fall rather than challenge the liberty of a single termite. Is the *declared* enemy any less an enemy? In the university of the future, I believe, we shall be less tolerant of the shifty dialectician, the self-confessed destroyer. We shall strive for excellence. We shall enlarge our national

Pantheon without apologies to the hero defilers. We shall teach young men the glories of unwavering faith and unselfish deeds that "no fury of wind can destroy."

Our future fate will be largely the outgrowth of our present course of action. Destructive agriculture, overgrazing of grasslands, the stripping of headwater forests, each inevitably means a descent in standard of living of that part of the population which is dependent upon these resources. For population is not fluid: internal migration has rather narrow limits despite its spectacular aspects. Men are tied to place to a high degree whatever *one* man or small groups of men may do. This is largely due to the law of *commitment*: as a man becomes established he gives hostages to place. Houses, fences, invested money and affection for neighborhood and homesite, as well as aversion to uncertain risks elsewhere, all play their part in holding men to failing enterprise and occupation. When the erosion of men's fortunes is most gradual it is most deadly. A sweeping loss by flood or fire imposes a sudden and dramatic decision. A delayed decision is more likely if there is gradual loss of grass, forests, soils, and minerals. The scientific task is to identify destructive process before it reaches disastrous proportions. This has now become a chief social problem also because we are at the moment taxing heavily the enterprise and resources of the whole country to make up for past neglect of particular areas. We have also set national standards in road quality, car ownership, which gives mobility of labor supply and recreation, and schools that marginal areas cannot support unless land-use passes under the imperative controls identified by scientific study.

Fate is not all mystery. In large sectors of human action, the outcome is dependent upon our own intelligence, endurance, imagination, and will. So complex are the forces of nature and

society in our day that we cannot *feel* our way through difficulties; we must *think* our way through them. Feeling can inspire action as we view the majesty of large-scale effort along the intelligently chosen way. To make nature itself give ground to human management, here and there, is a theme for the poet: "No ascent is too steep for mortals."

The lines were written before science had displaced "the books of incantations" that sought "to unfix the stars" while the fateful earth underneath was neglected. The folly dissolves when we discover natural laws and shape social purpose accordingly. No use to look at the stars in that half of the United States in which success or failure depends upon the control of the water through special forms of cultivation or selection of a crop adapted to low and uncertain rainfall.

While historical research cannot supply the power of forecast, it can enrich the context of our thinking, provide a broader background of understanding, deepen the insight into the resources and motives of men. It enables men to *devise ways more likely to work well* because action is based upon a finer and surer judgment as to what, I repeat, men can do, or will do, or can be persuaded to do. A scientific study of the natural origins of a good soil, of the natural processes of replenishment of fertility, is not enough. Why men in their different societies failed or succeeded is the indispensable other half of the story.

In the United States we have been *trading regional advantages* in the past with wide margins of safety supplied by new regions. To see this clearly is to strengthen the conviction that we have not, as a people, settled down upon our national estate. The Pacific Northwest has 55 per cent of the entire remaining virgin forest of the country. Forest industries support only 25 per cent of the population and employ, in Oregon and Washington together, 59 per cent of all the workers engaged in industrial activities. Yet in ten years it will be a distressed area if the

present rate of timber cutting is continued. Replacement by planting and natural growth is too slow to delay by more than a few years the contraction of the lumber industry to an extent that will disrupt the entire economic life of the region if new resources are not found. We seem unable, as a nation, to act until destruction is palpable, until everyone with a vote is convinced that disaster is at the door. Our inaction with respect to flood control carried the absurdity to even greater length: we merely hoped that in the next flood the swollen streams would not rise so high, although science had demonstrated that sooner or later there would be a higher flood.

In our favored land, as in all lands, "nothing is happy altogether." We occupy, we waste, we suffer, until one day we discover, and report, and at length discuss the common good. The hope arises that with intelligence and spirit we can one day build in America a *Civitas Dei* out of familiar materials. Statistics are needed for that city as well as hope and faith. Carvers and goldsmiths, cedar and fir, oil and grain are the media of the builders. But over and through all is spirit. This is compounded of faith in the good will and the informed judgment of common people; in the search for and the use of our best not our meanest intelligences; in the university's relentless insistence upon excellence; in scorn of those who put cynicism and cleverness above self-sacrifice; in unremitting concern for the poor; in a lively sense of the social responsibilities attached to the privileged life of scholarship. Justice Oliver Wendell Holmes' remark, "I have labored carefully not to mock, lament, and execrate the actions of men; I have labored to understand them," is a good social text for a university man as for the average citizen.

Some sense of glory there must be too if we would unfix the stars. Here and there must be men of vision who proclaim what America can be: men who cherish the unburied past of heroic

deeds and ringing words: ever-remembering men: men flashing the signals of deeds done in high spirit. The university, like the church and the market and the court, must proclaim that only such men are fit for our America. We can fortetell that America only if we here and now resolve to make that which we foretell. The land is fit for it if we care for it, our stock is capable, our culture maturing.

O fortunatos nimium sua si bona norint.

“Oh only too happy if they could know the advantages they possess.”

The New Frontiers in the Atom

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INTRODUCTION

THE ANNIVERSARY CELEBRATION of a great university is indeed an important occasion, and it is appropriate to signalize the event by a symposium on "The University and the Future of America," for a great institution of learning is eternally youthful, and youth looks always to the future. I am greatly honored to be included in this distinguished gathering, and it gives me especial pleasure to join in wishing our sister institution many happy returns.

In a discussion bearing on the future, the scientist is always in something of a dilemma. On the one hand, he is cautioned to make only very limited prognostications, for he has learned the very limited region of applicability of existing knowledge and the likelihood of error in speculation. On the other hand, he faces the future with eager excitement and curiosity about what is beyond the present frontiers of knowledge, and he is naturally tempted to speculate and indeed to indulge in day-dreams. Perhaps I may convey something of what is in the minds of physicists these days by a brief discussion of some recent developments of the current intensive attack on the new frontier in the atomic world—the nucleus of the atom.

ATOMS

The atomic constitution of matter has long been a keystone of natural science. At the beginning of this century it was a key-

stone in a structure having as pillars the principles of the conservation of energy and the indestructibility of matter. In the '90's, it was almost axiomatic to say that the building blocks of nature are the atoms—indivisible, indestructible entities, permanent for all time. But the discovery of radioactivity altered all this. There followed the discovery of the electron and the proton as smaller and more fundamental constituents of matter, and the atom itself became the happy hunting ground of the experimental physicist. Atomic physics developed rapidly; for the atom was found to be a domain of almost incredible richness and today, thanks perhaps to the newspapers, our children speak knowingly of smashing atoms!

To explain the wonderful phenomena of radioactivity, Rutherford came forward in 1904 with a revolutionary hypothesis which reduced the complicated and mysterious observations of radioactivity to simple order. According to Rutherford, not all of the atoms have existed for ages and will exist for all time, but there are some atoms in nature that are energetically unstable and in the course of time, of their own accord, blow up with explosive violence. These are the natural radioactive substance, and the fragments given off in the atomic explosions are the observed penetrating rays.

It was not long before Rutherford's hypothesis was established as a law of nature and formed a greater keystone, replacing the chemists' conception of the atom and serving as a foundation for a new science, the science of the atomic nucleus.

Time does not permit an adequate historical résumé of the development of nuclear physics, but for the present purposes it is sufficient to say that the ideas of Rutherford and Bohr on the structure of atoms are now firmly established. There is an abundance of evidence that an atom consists of a nebulous cloud of planetary electrons whirling about a very dense sun, the positively charged nucleus, and that it is in the nucleus that the

atomic explosions of radioactivity occur. Indeed, our assurance that this is so rivals our confidence that the planets revolve about the sun!

ATOMIC NUCLEUS

Let us now proceed immediately to a consideration of the structure of the nucleus. The nucleus consists of a closely packed group of protons and neutrons, elementary building blocks of nature some 2,000 times heavier than the electrons. The neutrons are electrically neutral while the protons carry positive charges and for each proton in the nucleus there is a corresponding negative electron outside, for the atom as a whole is uncharged. Since the number of electrons outside determines the ordinary chemical and physical properties of the atom, it follows that the nuclear charge determines the place of the atom in the periodic table of the elements.

Thus, the nucleus is the body and soul of the atom. More than 99.9 per cent of the atom's mass is in the nucleus and the nuclear charge determines the nature of the atom, its chemical and physical properties.

TRANSMUTATION OF THE ELEMENTS

These considerations reduce the age-old problem of alchemy to simple terms. For we see to change one element into another is simply to change the nuclear charge, i.e., the number of protons, in the nucleus. The subject of transmutation of the elements has recently received a great deal of attention in the laboratory. All sorts of transmutations have been produced on a minute scale—helium has been made from lithium, magnesium from sodium, and even mercury has been turned into gold. The day may come when we will indeed possess the philosopher's stone and will be able to transmute the elements on a grand scale. But interesting as these developments are, I

should like to draw your attention to two other subjects, artificial radioactivity and the question of tapping the vast reservoir of energy in the nucleus of the atom.

ARTIFICIAL RADIOACTIVITY

One of the early results of atomic bombardment was the discovery that neutrons could be knocked in or knocked out of the nucleus to produce radioactive isotopes of the ordinary elements. Thus, for example, the nucleus of the ordinary sodium atom contains 11 neutrons and 12 protons, 23 particles in all, and so it is called sodium 23 (or Na^{23}); and by bombardment it was found that a neutron could either be added to make sodium 24 or subtracted to make sodium 22, both isotopic forms not occurring in the natural state. The reason that these synthetic forms are not found in nature is that they are energetically unstable. They are radioactive and in the course of time blow up with explosive violence. Sodium 24 has a half-life of 14.5 hours, i.e., it has an even chance of disintegrating in that time, turning into magnesium by the emission of an electron. Sodium 22, on the other hand, has a half-life of 3 years and emits positive electrons to turn to stable neon 22.

These artificial radioactive isotopes of the elements are indistinguishable from their ordinary stable relatives until the instant they manifest their radioactivity. This fact deserves emphasis, and it may be illustrated further by the case of chlorine. Chlorine consists of a mixture of two isotopes, 76 per cent of Cl^{35} and 24 per cent of Cl^{37} , resulting in a chemical atomic weight of 35.46, which is the average weight of the mixture. By elaborate technique, to be sure, it is possible to take advantage of the extremely slight difference in chemical properties and bring about separation of these isotopes; but in ordinary chemical, physical, and biological processes the chlorine isotopes are indistinguishable and inseparable. The artificial radioactive

isotopes Cl^{34} and Cl^{38} are likewise indistinguishable. In fact, Cl^{34} is more nearly identical in properties to the natural isotope Cl^{35} than is the other natural isotope Cl^{37} . And again I would say that the radioactive characteristic of Cl^{34} becomes evident only at the moment it blows up to turn into the neighbor-element sulphur.

RADIOACTIVE TRACER ATOMS

In these radioactive transformations of the artificial radioactive isotopes, the radiations given off are so energetic that the radiations from individual atoms can be detected with rugged and reliable instruments, called Geiger counters. Thus, radioactive isotopes can be admixed with ordinary chemicals to serve as tracer elements in complicated chemical or biological processes.

As an illustration of the power of this new technique of labeling and tracing atoms, let us consider iodine in relation to the thyroid gland. It is well known that the thyroid takes up and stores iodine, and this fact can be demonstrated strikingly by feeding an individual iodine including a small quantity of radioactive iodine. Before the feeding, the radioactivity of the food can be measured by placing it near a Geiger counter, thereby giving a measure of the iodine content. Later the progress of the iodine through the body can be observed by placing the Geiger counter next to various parts of the body. Likewise, the proportion of the fed iodine in the various body fluids at any time can be determined quickly by taking small samples of the fluids and measuring their radioactivity. After some hours it is found that a large part of the iodine taken in has collected in the thyroid, a fact that is readily established by placing a Geiger counter next to the gland (Fig. 1) and observing the activity while finding no appreciable activity elsewhere. This technique makes it possible to study the behavior of the thyroid in health

and in disease, and much interesting work along this line has been carried out recently.

RADIO-AUTOGRAPHY

Although the tracer elements are readily detected with the Geiger counter, there is a photographic method which for many purposes has obvious advantages. This method is sometimes called radio-autography and is illustrated by Figure 2. Here a minute amount of radioactive phosphorus in the form of sodium phosphate was added to the nutrient solution of a tomato plant, and after a day or so leaves were placed against a photographic film enclosed in a light-tight paper envelope. The penetrating rays from the radioactive phosphorus produced the developed contact image shown in the figure, which gives an accurate and detailed picture of the uptake of phosphate by the plant. Now, indeed, the same method works very well also for the thyroid, as is shown in Figure 3, which is a photomicrograph of a thin section of thyroid tissue containing radio-iodine; alongside is the radio-autograph obtained from the same micro section by placing it against a photographic plate. The distribution of the iodine in various parts of the gland is shown in surprising detail.

Similarly striking radio-autographs of the distribution of phosphorus and strontium in rats are shown in Figure 4. Here two rats were fed radio-phosphorus and radio-strontium, respectively, and then some hours or days later they were sacrificed and frozen sections of the entire bodies of the animals were placed against a photographic plate. The resulting radio-autographs show clearly that both strontium and phosphorus are selectively deposited in the bones, phosphorus being more widely distributed in other tissue. The distribution of the strontium in the bones also appears to be quite different from that of phosphorus, as radio-autographs of the sections of bones clearly show (Fig. 5).

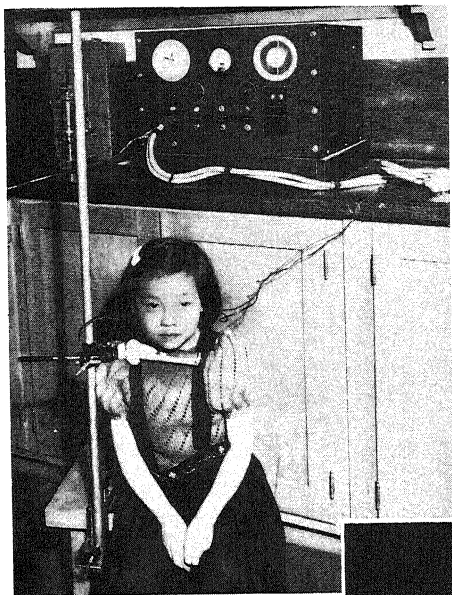


FIG. 1. The experimental arrangement for the detection of the presence of radioactive iodine in the thyroid gland. The Geiger counter tube is placed against the neck and the radioactivity is recorded by the instrument on the table.

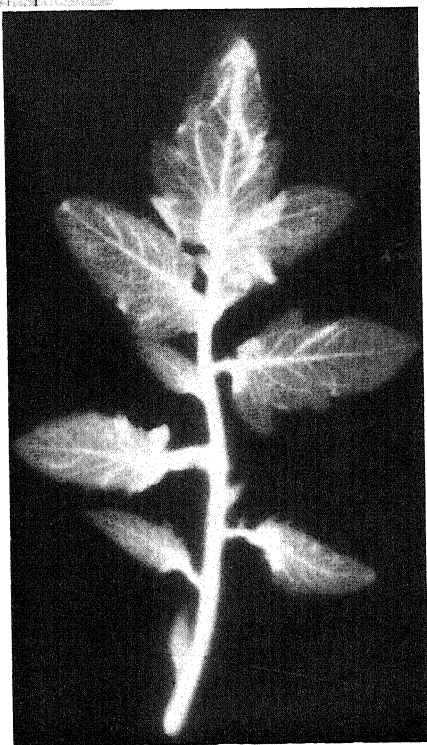


FIG. 2. Radio-autograph of the distribution of radio-phosphorus in the leaves of a tomato plant. The leaves were taken from the plant 36 hours after radio-phosphorus had been introduced into the solution in which the plant grew. The light areas are the regions where the greatest accumulation of radio-phosphorus took place in the leaves.

FIG. 3. Photomicrograph of a section of thyroid tissue and its corresponding radioautograph from a patient with a cancer of the thyroid (X 50). The diffuse cellular area covering the right half of the section is made up of cancerous thyroid tissue. To the left are three small islands of uninvaded thyroid tissue which accumulated most of the radio-iodine. In the radioautograph shown here the areas of darkening correspond to the regions of greatest deposition of radio-iodine.

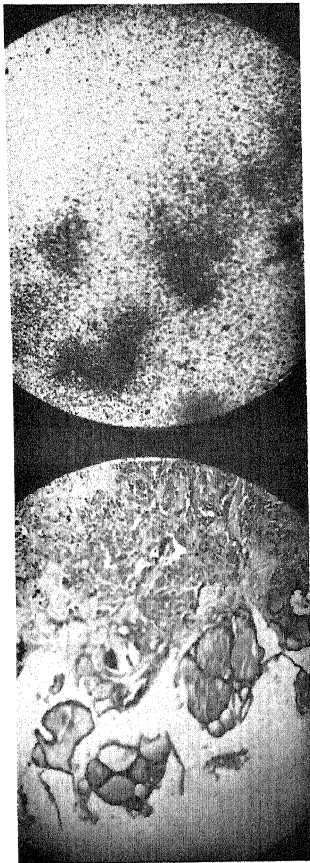


FIG. 4. The difference in distribution of recently absorbed radio-phosphorus and radio-strontium in rats as demonstrated by the technique of radio-autography. On the left the regions of greatest deposition of radio-phosphorus, can be seen to be distributed not only through the bones but also in the soft tissues. On the right, however, the radio-strontium was almost exclusively accumulated in the bones with very little present in the soft tissues, as can be seen by the outlines of the animal's head and vertebral column.

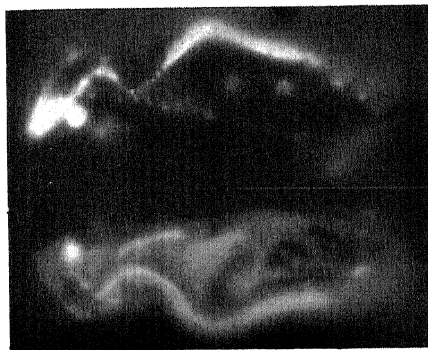
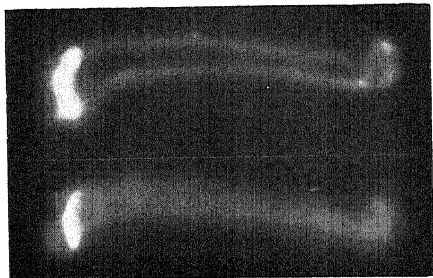


FIG. 5. Radio - autograph from thin slices of two rabbit femurs, the one on the right from an animal fed radio-strontium, the one on the left from an animal fed radio-phosphorus. It is seen that the strontium is deposited largely in the ends of the femur while the phosphorus appears to be more evenly distributed throughout the entire length of the bone.



These examples serve to illustrate the power of the new technique of radioactive tracer atoms. It has often been said that the progress of science is the progress of new tools and new techniques, and I think we may look forward to accelerated developments in biology resulting from the tracer elements.

ARTIFICIAL RADIOACTIVE SUBSTANCES IN THERAPY

It is somewhat afiel for me to discuss medical problems, but I should like to direct your attention to the possibilities of the artificial radioactive substances in the treatment of cancer and allied diseases. It is well known that at the present time there are two main approaches to the treatment of neoplastic disease, surgery and radiation. It is sometimes possible to cut out a cancer completely and effect a cure, and in other circumstances it is possible to destroy a tumor by irradiation with X-rays or radium. The mechanism whereby the radiation destroys the tumor without destroying an excessive amount of surrounding normal tissue is doubtless extremely complicated, but in any case it is evidently important to localize the radiation to the tumor as much as possible. Perhaps the ideal would be approached if a means were at hand to irradiate each and every malignant cell without irradiating a single normal cell.

The artificial radioactive substances open for the first time the possibility of an approach to such selective irradiation of tissue. The above examples of tracers suggest the treatment of thyroid tumors with radioactive iodine, bone tumors with radioactive strontium and radioactive phosphorus. These possibilities are being investigated, as is the more specific problem of finding a radioactive substance that is selectively taken up by tumor tissue. If there were time, I should like to describe work along this line in progress in several laboratories, and especially to speak of the important progress that is being made in the treatment of leukemia; but I must content myself with only

mentioning these new developments in medicine, which are so promising for the future.

ATOMIC ENERGY

For a long time astronomers have been vexed with a problem, the problem of the source of stellar energy; for there is evidence that the sun has been blazing at its present brilliance for thousands of millions of years, and no ordinary fuel could be responsible for such an eternal fire.

The discovery of radium posed to the physicist a similar difficulty; for it was found that radium gives off every hour enough energy to heat its own weight of water to boiling, and this it continues to do for more than a thousand years. Such a vast source of energy in the radium atom was as difficult to understand as the evidently limitless store of heat in the sun. The problem was of fundamental interest and all sorts of possibilities were considered, even to the abandonment of the principle of the conservation of energy.

But the first clue to the solution of the problem appeared in 1905 when Einstein announced the theory of relativity. One of the revolutionary consequences of the theory was that matter is a form of energy and that presumably in nature processes go on in which matter is destroyed and transformed into more familiar forms of energy such as heat, radiation, and mechanical motion. The relativity theory gave as the conversion factor relating mass to equivalent energy the square of the velocity of light—a very large number, even to an astronomer! Thus the theory indicated that, if a glass of water were completely destroyed, more than a billion kilowatt hours of energy would be released, enough to supply a city with light and power for quite a time!

This exciting deduction was immediately accepted by the astronomers, who said: "Doubtless within the sun conditions

are such that matter is being transformed to heat. Thus, slowly through the ages the sun is losing mass; its very substance is radiating into space."

Likewise, the physicists, who had other compelling reasons for accepting the Einstein theory, concluded that the source of the energy in the radium atom was a destruction of matter in the atomic explosion giving rise to the penetrating rays.

Although the fundamental assumptions on which the relativity theory was based were evidently sound, and the explanations of the source of energy of the sun and stars and radioactivity were most attractive, until direct experimental verification was forthcoming, Einstein's great deduction could not be regarded as an established law of nature.

The first direct evidence of the truth of this fundamental principle was obtained in the first atom-smashing experiments a decade ago. It was observed that, when the nucleus of a lithium atom is hit by a proton having a kinetic energy of less than a million electron-volts, the result is the formation of two helium nuclei which fly apart with an energy of more than 17 million electron-volts; thus in the nuclear reaction in which hydrogen and lithium unite to form two helium atoms there is a great release of kinetic energy.

Now one of the interesting and important occupations of the experimental physicist has been the measurement of the masses of atoms; and the weights of atoms are known with great precision—much greater than any individual knows his own weight. In particular, it was known precisely that a lithium atom and a hydrogen atom have a total weight slightly greater than the weight of two helium atoms, and it was a great triumph for the Einstein theory when measurements showed that the excess kinetic energy with which the helium atoms flew apart in the hydrogen-lithium reaction corresponded exactly with the

Literally hundreds of similar nuclear reactions have been studied in the intervening years, and in each instance the Einstein relation has been verified. At the present time this great principle has as firm an experimental foundation as any of our laws of nature.

URANIUM FISSION

Now that it is an experimental fact that matter can be converted into energy, it becomes of great practical importance to inquire whether the vast store of energy in the atom will be tapped for useful purposes. This question has recently taken on added interest through the discovery of a new type of nuclear reaction involving the heavy element uranium.

It has been known for some years that the heavy elements, such as lead, gold, and uranium, are relatively heavier than the middle-weight elements, such as copper and iron, or more precisely that the average weight of the neutrons, protons, and electrons in the heavy elements is greater than their average weight in the atoms near the middle of the periodic table. Accordingly it is to be expected that, if heavy atoms were split approximately in two, forming corresponding middle-weight atoms, there would be a vast release of energy corresponding to the disappearance of matter in the transformation. Indeed, from known values of the masses it can be calculated on the basis of Einstein's mass-energy relation that each splitting or fission, as the process is called, of a uranium atom into two approximately equal parts releases an energy of about 200 million electron-volts, which is millions of times more heat per atom than is given off when ordinary fuel is burned. Thus calculations show that 100 pounds of uranium would yield a billion kilowatt hours, which at one cent per kilowatt hour would be ten million dollars' worth of electrical energy.

For some time these considerations were largely academic

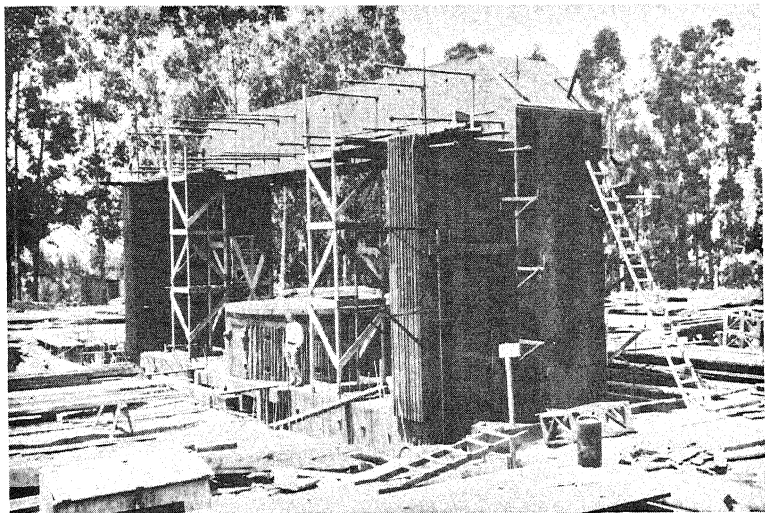


FIG. 6. A general view of the partially assembled magnet yoke of the 100-million-volt cyclotron now under construction on Charter Hill in Berkeley—nearly four thousand tons of steel.

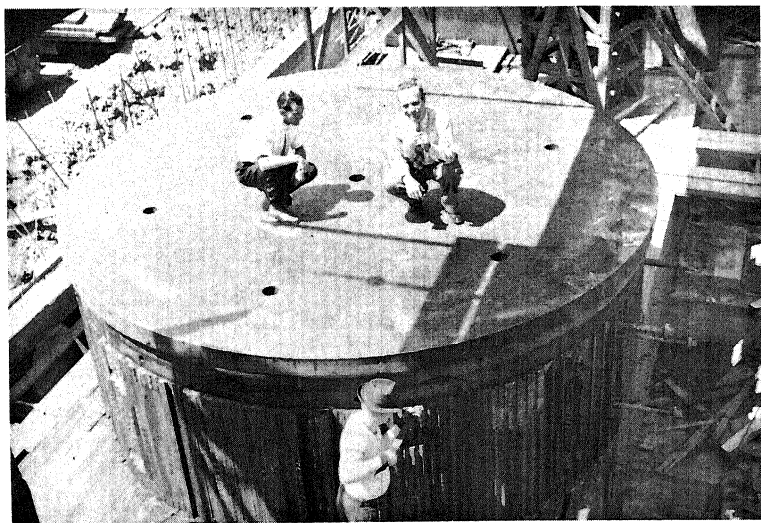


FIG. 7. The lower pole face 184 inches in diameter of the giant magnet. Around each pole will be wound one hundred fifty tons of copper coils.

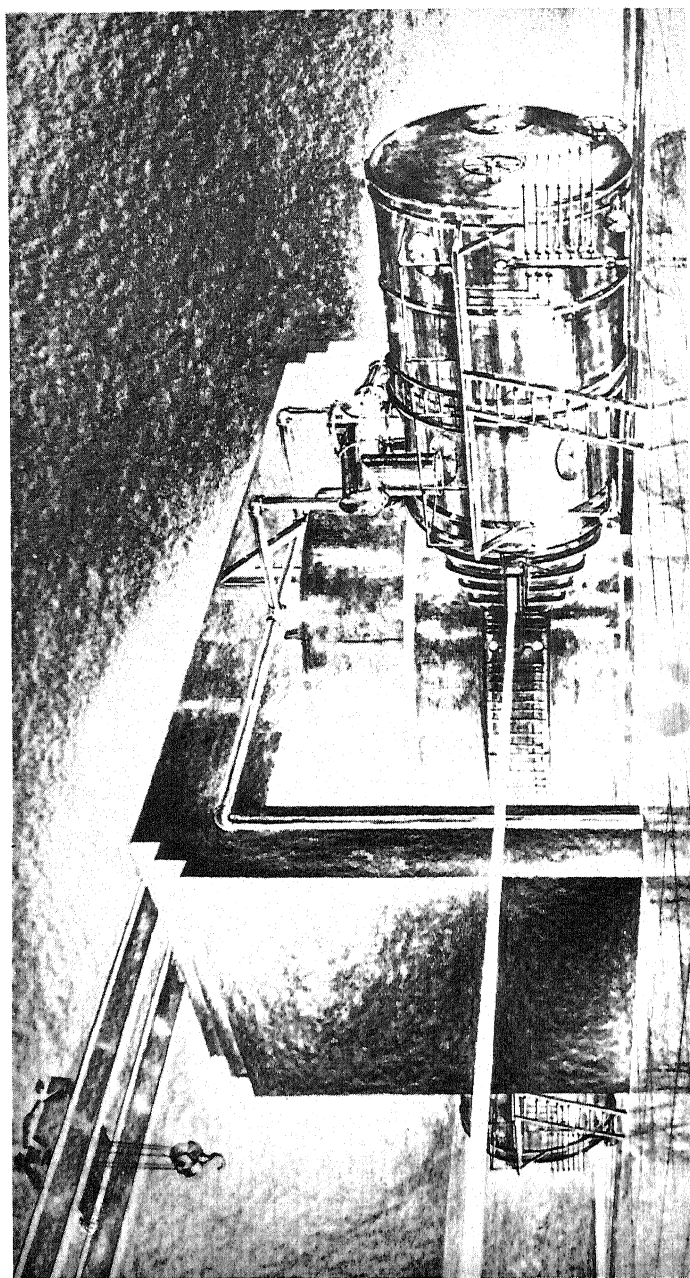


FIG. 8. Artist's sketch from engineering drawings of giant cyclotron in operation projecting into the air luminous beam of 100-million-volt heavy hydrogen atomic projectiles to a distance of about one hundred forty feet.

because no way was known for producing fission of the heavy elements. But interest in the matter has now become extremely lively as a result of the discovery that fission of uranium is actually brought about by bombarding it with neutrons.

The phenomenon has, during the past two years, received intensive study in laboratories all over the world and several salient facts have emerged. First, the rare U^{235} isotope undergoes fission after absorption of a slow neutron. Second, the energy released in the fission process has been measured; and, as expected, it is found that, when a neutron having an energy less than an electron-volt enters the U^{235} nucleus, about 200 million electron-volts of energy is released. Third, it is found also that the fission process is so violent that usually the U^{235} nucleus does not break up into two parts only, but more often several neutrons are given off in addition to the two large fragments.

That neutrons are generated in the fission process is of the greatest interest because it opens up the possibility of a chain reaction, a series of nuclear reactions wherein the neutrons liberated in one fission process go on to produce additional fissions in other atoms, which in turn give rise to more neutrons, which produce further fissions, and so on. It is this possibility of a chain reaction that has excited the interest in uranium as a practical source of atomic energy.

Without going into further detail, it is perhaps sufficient to say that there is some evidence now that, if U^{235} could be separated in quantity from the natural mixture of the isotopes, a chain reaction could, indeed, be produced. But herein lies the catch, for there is no practical large-scale way in sight of separating the isotopes of the heavy elements, and certainly it is doubtful if a way will be found.

But I should not want to indicate that the uranium matter is a disappointment, that after all we shall never find a way to

bring about fission of the heavy elements for useful purposes. Quite the contrary!

The present situation is not unlike the circumstances fifty years ago surrounding the then great question of whether man would ever be able to fly. In those days the fundamental laws of classical mechanics were known, and they allowed the possibility of heavier than air flight. Moreover, there was an abundance of supporting observational evidence that flight should be possible: there were kites and there were the birds of the air. But man's realization of the dream awaited primarily the development of the combustion engine, a circumstance not so evidently connected with the fundamental problem of flight. Likewise the fundamental laws of nature recently revealed to us allow the possibility of obtaining useful nuclear energy, and radium and the sun and stars bear witness that this vast source of energy is being tapped in nature. Again success in this direction may await the development of a new instrument or technique just as the airplane depended on the gas engine.

Perhaps the problem awaits a deeper understanding of the forces that hold nuclei together. That there are little understood forces operative in the nucleus is more than evident; especially from observations of the cosmic rays, it has been established that particles of matter called mesotrons of intermediate mass between electrons and protons play a dominant role in nuclear structure. Theoretical considerations suggest that the mesotrons may be connected with the primary forces in the nucleus; and, accordingly, an understanding of mesotron forces may ultimately yield the solution of the practical problem of atomic energy.

THE GIANT CYCLOTRON

In order to study experimentally the mesotron problem, it is necessary to bombard nuclei with atomic projectiles having

energies in the range of 100 million electron-volts rather than in the neighborhood of 10 million electron-volts at present available in cyclotron laboratories. To this end a giant cyclotron is now under construction on Charter Hill in Berkeley, and I should like to conclude with some pictures of this great machine. Whether it will be the key to the vast store of energy in the atom, what new discoveries, what new insight into nature it will bring—only the future will tell!

Three Weaknesses in the American Educational System and the Possible Remedies

ROBERT ANDREWS MILLIKAN

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AS AN INTRODUCTION to my theme I wish to present certain basic principles which in my thinking must underlie a sound educational system in a democracy—or more accurately in a country which is trying to maintain a free, representative (parliamentary or republican) form of government; for since the days of Plato and his republic no real thinker has ever maintained that a pure democracy was a possible permanent form of government, at least in a large country. I propose to approach this question through some consideration of the history of thought on the relation of education to the central government.

If we go back to the philosophy of one of the most penetrating and gifted thinkers of all time, Spinoza, education should not be a function of the central government at all. He reached that conclusion because he felt that it would inevitably be that those in control of the State would use education, if it were in their hands, to perpetuate their control, i.e., to indoctrinate the rising generation with their own particular points of view, and these would of course be a reflection of their own interests. For it is almost universally true that men who rise to great power develop a veritable genius for identifying the public good with

the perpetuation of their own authority. When one sees the kind of indoctrination which is now going on in Russia and in Germany, and how close we have been coming to it in our own country during the past decade in our use of government propaganda, one inevitably begins to wonder whether the world would not be better off if it had followed Spinoza's advice about the entire divorce of education at least from the central government.

It is certainly a fair question, and one to which some of the best historians have already given a positive answer, whether the complete domination of education in all its stages by the German government was not the primary cause of the World War (this has been definitely asserted and I think proved by the German philosopher, Foerster), and also whether the intensive growth of nationalism the world over today does not find its root in the same cause. In raising these questions have I not suggested the most potent reason for thankfulness that we, in the United States, have as yet an educational system that is independent of the federal government and not at all completely dominated by the governments of the forty-eight individual states? Our secondary public schools are mainly supported by the local communities through local taxes. Our higher educational system, i.e., colleges and universities, are roughly half supported by the several states and half under private control. We are moving in the direction of state support and state control, especially in the West; but I hope that the awakening thoughtfulness of our people will at least maintain the wholesome balance that as yet exists between our higher state and our private educational systems. It is true that outside the Anglo-Saxon countries there is today almost complete domination of education in all its phases by the central government. Even in England, which has had for centuries a glorious record of an essentially privately controlled educational system, during the

past twenty years the trend has been rapidly toward state support, with what result it is as yet much too early to determine.

Turning now from Spinoza's thinking, which has stood in most respects the test of time better than that of most philosophers, let me give a bit of my own educational experience.

When I went to Germany as a graduate student in 1895, although I had gone there primarily to study physics, one of the first courses for which I registered was Professor Friedrich Paulsen's course on the philosophy of education. Let me summarize my memory of the main point of view taken by Paulsen, then regarded as unquestionably the foremost educational philosopher of Germany. He spoke about as follows:

During the last decade (that of the eighteen-eighties*) an American, Mr. Edward Bellamy, pictured an educational Utopia substantially thus: Let all the youth of a country be subjected to essentially the same educational process up to the age of from sixteen to eighteen. Then let them with that background of maturity and education choose the kind of careers they wish to follow, and then through suitable apprenticeships or vocational schools fit themselves for effectiveness in these chosen fields.

"Now," said Professor Paulsen, "this general Utopian scheme of Mr. Bellamy's will not work in practice, and the fundamental reason therefor is that the average human being is not fitted for, nor much *interested* in, intellectual processes. Mr. Bellamy's first eighteen years would necessarily be devoted in the main to such processes. Mr. Everyman does not enjoy being forced to think too much of the time. It is too hard work for him. He does not do it well. He is very much happier at an essentially routine occupation in which through the repetitive process he develops manual dexterity, like the carpenter's or the pianist's, or social effectiveness like the salesman's or the actor's. We shall only make mankind generally unhappy by trying to give every-

* Bellamy's *Looking Backward* was published in 1888.

one a broad intellectual background of the kind envisaged by Bellamy. My own outline," said Paulsen, "of a wise educational system in contrast to his is somewhat as follows:

"Let all of our children go through the same educational process only up to the age of, say, ten. Then let those who are going to be farmers be separated from the rest and given instruction designed primarily to make them good farmers. At thirteen separate out another group that is going into the mechanical trades, and thenceforth let them be trained in mechanical schools. Similarly, at fourteen or fifteen separate out a group that is to handle commerce and give them the best possible training for it, including training in the modern languages. Let the rest go through the higher secondary school and at sixteen to eighteen be separated again into those who are going into the army and navy, into artistry in most of its forms, and other gentlemanly pursuits; while the remainder, now consisting of those destined for the intellectual professions—law, medicine, theology, teaching, writing, engineering, government, finance, economics, management—go to the university and the technical school and take the long and difficult training that is necessary to acquire competence in these professions."

As I listened to this outline of Paulsen's, I said to myself: it may be that that is the best system for Germany; but I cannot believe that it is the best system for a democratic country like the United States. It is a system that develops naturally in countries like most of those existing in Europe in which there is a highly stratified society. Wherever the class system exists children necessarily follow the occupation into which they are born. This system of Paulsen's may indeed produce a nation that functions like a highly efficient machine, but at what a sacrifice of the freedom and individuality of the citizen! *Paulsen is doubtless correct in his statement that the average man is better fitted for, and happier in, a pursuit in which he develops skill*

by a large exercise of the repetitive process. Let us admit that at once, for surely no small fraction of the satisfactions of all of us come from the development of skills in the doing of routine operations, even if they are no more useful than those of golf or tennis or bowling. Most of the lives of all of us are routine. Routine operations skillfully done become art and art makes a more universal appeal than does knowledge. There is much unintelligent and unsound criticism of the routine of industry. We all enjoy doing the things we have learned to do with skill and dispatch.

Again, Professor Paulsen is right in his contention that only a small fraction of the population is qualified by its natural endowment for leading the intellectual development of a nation and that it is, therefore, of paramount importance that there be selected for this purpose only the most able, and those who have the most capacity for enduring the headaches that are the inevitable result of trying to solve new and difficult intellectual problems, some of which are insolvable anyway.

The one point at which I wish to take issue with him is in the *method by which the selection for that purpose is made.* Paulsen's children have opportunity only within their social group. America is the land in which, thus far at least, our most cherished ideal has been to *broaden the base* of that opportunity so that each individual may have some chance at least to show his own quality, to develop his own interest, and reveal his own aptitudes. Paulsen's system is natural for a despotism, for any thoroughly regimented society; but that is just what we are trying in America to avoid. It is not right for a society that seeks to maintain a representative form of government and to give to every child an opportunity to rise to the position to which his character, capacity, and energy entitle him. Why not? Because *no representative form of government can permanently endure unless at least fifty-one per cent of the voters*

are capable of casting intelligent votes, and this requires a fairly broad education up to the age of seventeen or eighteen. By that time, too, the youth should have been given his opportunity to show the place in which he belongs in a competitive world. That is why the United States has actually moved since 1890 in the direction of Bellamy rather than in the direction of Paulsen; and I for one am glad of it. For our watchword has always been, not equality—that is impossible, since we are so differently endowed—but equality of opportunity to find where each of us has the best chance of succeeding and therefore of having a happy and useful life.

How far have we actually moved in Bellamy's direction? So far as to well-nigh realize his Utopia. Because of legislation enacted chiefly in the last thirty years, practically the whole of the oncoming generation in America is required by law to remain in our public or private secondary schools until the age of sixteen or eighteen, just as in Bellamy's Utopia. Five of our states require every boy and girl to attend school up to the age of eighteen, five more up to the age of seventeen, and thirty-one up to the age of sixteen. According to the Commissioner of Education's reports, ninety-seven per cent of our children between five and thirteen are in school, and over sixty-six per cent of those between fourteen and seventeen. In a word, now for the first time in the United States, or I believe in any country, practically the whole of the oncoming generation comes for a period of years at the formative age under the influence of the group of educated men and women who constitute the secondary-school teachers of the country. These secondary-school teachers, therefore, have it in their power largely to determine the character, the tastes, the ideals, the habits of thought and of work of the next generation of citizens of the United States—to give them an education based on a few established, noncontroversial, fundamental truths, not prejudices.

What an opportunity? Is the secondary-school teacher conscious of it, and is he rising to that opportunity—the opportunity now offered in our democracies for the first time in history to create a new world in one generation, in fifteen years? Here is the supreme problem of the secondary school in the United States, and it is only within the last twenty-five years that this opportunity has been created.

A word, too, ought to be said about how the foregoing immense opportunity has been brought about. When I graduated from high school in 1885, there were considerably less than 500,000 pupils in the secondary schools of the United States—less than a tenth as many as now. What has made this new situation possible? *Simply the improved economic situation of the United States brought about by the applications in our country of the results of science to our human life.* For the purpose of this address we will call it the *application of science to industry*. The most important social value of science is *in making educational opportunity possible to everyone.*

How are we using that matchless opportunity? Not yet very well. Certainly if the foregoing principles underlying a sound educational system in a democracy are correct, then it is altogether obvious that very grave weaknesses inhere in our present educational procedures in the United States. The first and probably the gravest of these weaknesses applies both to the secondary school and to our higher educational system represented by our colleges and universities. Since only a small fraction of the whole population, say a tenth or even an eighth, can possibly be supported in what may be roughly called the intellectual or analytical professions, and since the success of democracies must clearly depend upon their ability to bring into such positions of leadership that tenth or eighth of the population that is best endowed for such leadership, it follows that perhaps the most important task of the whole educational

system in a democracy should be to do that selecting, and indeed to do it better than any totalitarian or other competing system can do it. Our educational system has in no sense as yet lived up to its opportunity and its responsibility in this matter of selection. Instead of mercifully guiding away from college and university the nine-tenths of the secondary-school population which has no chance of succeeding in the analytical pursuits for which the so-called higher educational system is supposed to train, we have taken down most of the bars between the secondary and higher systems and urged, almost driven, students to go right on and try to prepare themselves for pursuits in which there is no place for those of their endowments. It is the height of cruelty to the victim and his family and disastrous to the state, as are indeed all misfits, since they tend to undermine it through producing discontent and social unrest.

The fault lies at the door of both the secondary school and the college or university, and both must participate in the remedy. The higher schools must set up better standards for entrance, or do a better sifting job at entrance; and most of them have a long way to go in learning how best to do this. From my point of view the accrediting system so widely used in this country has been tried in the balance and found wanting. It began in the period preceding our embarkation upon the program of universal secondary education when the secondary schools themselves had less than a tenth of their present enrollment and were themselves much more selective than they now are in the background and the quality of the students who went through them. The taking of the whole population of secondary-school age into the high school necessarily lowered the average quality. That was a sacrifice we had to make in order to give every American youth his chance up to the age of seventeen or eighteen to show what was in him, what his

character and aptitudes and interests were. Having embarked upon that policy the necessity was upon us to do a vastly bigger job of vocational guidance within the secondary school and a better sifting job between the high school and the university than we had ever done before—to treat, essentially as proposed by Bellamy, the secondary-school years up to seventeen or eighteen, i.e., up to the end of the twelfth grade, as trying-out years for the distribution of the youth of the oncoming generation each into the particular niche in our social structure in which he would be most useful, most successful, and therefore most happy; for nothing is more conducive to misery in life than the feeling of being unequal to one's job. The problem of doing the testing, examining, and determining of the aptitudes, character, and abilities of the youth coming under his direction is in my judgment the big end of the secondary-school teacher's job in comparison with which lecturing interestingly to classes is of trivial importance.

The kind of selection done by the higher school among the applicants who seek to enter it is also of major importance. It is now being done reasonably well by some of the private colleges, but in general it is a very weak spot in American higher education. England, the Scandinavian countries, France, Canada, and some other countries, have an examination system for entrance into their higher schools vastly better than ours, and with our universal education we need it more than they do—some kind of a hurdle set up by the higher schools which provides that it is indeed the most competent tenth of the product of the lower schools that after completing the public school system at the end of the twelfth grade goes on into the higher school system. Letting students enter and then expelling them is a cruel and inhuman procedure. It subjects the expelled student to a public humiliation from which he may not recover. That method was given up twenty years ago at the California

Institute of Technology because of the conviction that the Institute was not doing its own job properly if it was not able by suitable entrance tests to determine whether the candidate could profit or not by the kind of work it was prepared to offer him. Since then there has been at C. I. T. a very low mortality among entering students.

The weakness here under discussion in the American educational system has perhaps been a natural result of the rapid growth during the past fifty years of the Western state university and the inevitable emphasis upon size which accompanies rapid growth. Reform might be expected to be shortly due were it not for the recent tendency, especially in California, toward the unnecessary multiplication by the state of four-year colleges. This tendency, born largely of political considerations rather than of need, may delay reform indefinitely. The rebellion of the taxpayer and the fact that the mechanic can earn a better living than the holder of a bachelor's degree seem to be about the most potent influences for checking the folly of the teacher organizations and the chambers of commerce.

The second weakness in American education is not unrelated to the first. As soon as it is recognized that but a small fraction of the population of the country can possibly earn its living through the learned or analytic professions, the question is raised, what is being done to fit the other nine-tenths into the niches in our society in which they can be most happy and most socially useful? The answer is *appallingly little*. We are said to have imported two million skilled mechanics from England and Europe because we needed them and were not producing them ourselves. The same is true of hotel stewards, for example, and many other branches of the service occupations.

It is strange but true that we professional educators, while we have spent no end of time on unimportant details of the curriculum, or on methods of teaching that make little difference

anyway, have almost completely ignored one of the most vital elements of a sound educational system in a democracy, namely, an effective apprenticeship system organized in co-operation with industry for the development of the occupational skills which are the very keystones of our progress as a great industrial and commercial people. The well-nigh complete blindness or indifference of the professional educator to this vital need of a universal educational system is, it seems to me, a very serious reflection upon us educators. We trail far behind England, the Scandinavian countries, France, Germany, Australia, and many other countries, when we ought to lead them all in the handling of the apprenticeship problem. Whether the incompetence of our educational leadership or the opposition of organized labor is chiefly responsible for our backwardness, I will not attempt to say. Fortunately, within the past few years a movement for the organization of an apprenticeship program in co-operation with industry has been started and is making considerable progress. The remedy is obvious. The Nazis have organized a tremendous program for the development of industrial and commercial skills among their whole population, each youth being taught more than one skill so as to provide as great a flexibility in skilled labor as possible. If our free system is not to go down in competition with their slave system, we must do it better than they. The weakness is clear and the remedy obvious.

The third weakness of education in the United States is our failure so far to utilize our universal secondary-educational system for the main purpose for which universal education in a democracy is usually urged, namely, for producing at least a fifty-one per cent of intelligent voters. Unless that can be done it is quite evident that a government based on universal suffrage cannot endure, as the dictators confidently predict that it will not. And it probably could not if we had not created through

our universal secondary-school system the opportunity to instill into the minds of at least sixty-seven per cent of our whole population in the age period from thirteen to eighteen the fundamental principles that underlie intelligent voting. Are we doing it now? Definitely no! Because we have not gone at it seriously enough and in the right way. Our courses in the constitution and government of the United States are trivial, ineffective things. I have recently made a suggestion of another approach which I think would be vastly more effective. I have thought at times that we could educate the adult population of the United States with the aid of the movie and the radio, but we are not now doing it well and I have about despaired of the efficiency of these agencies. As used, both of them are primarily the media for providing entertainment rather than education. But between the ages of thirteen and seventeen, or fourteen and eighteen, more than two-thirds of the youth of the United States are required to attend the high school for a serious educational purpose. Once a week in most schools the whole student body is required to attend the so-called assembly. Without attempting to change the curricula of the high schools at all, my suggestion is that for four consecutive years every week the assembly hour be systematically used for instilling the fundamental principles that underlie intelligent voting and rational living. Concretely, I would have some completely nonpolitical educational group charged with the responsibility of preparing a series of attractive talking movies. In one of them I would have Chief Justice Hughes, for example, whom every person in the United States would like to see and hear, present the necessity for obedience to law if organized society is to endure at all; and through arrangements with school superintendents I would have that movie go in succession to every high school in the United States. With such an audience and such an objective there is not a man in the United States who would not

gladly and freely give his services and do his utmost to make his presentation of the highest possible value. All controversial material would be avoided. Only fundamental basic principles which have become established and which are universally recognized by competent and informed men, but of which many people are ignorant, would be presented. The application of and reflection upon those principles could be left to the hearers. For the four most formative years of life I would expose once a week practically the whole of the oncoming generation of American citizens to canned talks or discussions of that sort on the fundamentals that underlie rational living and intelligent voting. Through such a technique would not the fundamental purpose of universal education of every citizen of a democracy up to the age of seventeen or eighteen be achieved, namely, the preservation of the free democratic way of life on earth? This third weakness thus far of the American educational system is obvious. Is not some such remedy worth trying?

Education and Social Control through Law

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As we are taught today, we cannot be assured of anything absolute or ultimate. But, as the Freshman theme said of its hero that he made himself immortal for a great many years, so we may say of civilization that it is approximately ultimate. Increasing adaptation of men both to their physical and to their human environment, whether we interpret it as an idea unfolding in human experience, or as an observed and verified phenomenon, or as a manifestation of an eternal reason, is as clearly given us as any starting point can be. If we can't see through to the end—and I am not among those who flatter themselves that they can—we can at least see a long way back, a long way on every side about us, and perhaps some little way ahead. For conceding that we are not in any wise in duty bound to keep to a line to which we have hewed in the past, what men do is very much conditioned by what they have been doing and have learned to do. The past, showing us where we have been going, and the present, indicating to us where we are going, must give us some idea of where we are going to go at least so far as we can foresee. We may well assume that men's feet are set in the path of this increasing adaptation to their environment.

Civilization, then, is the basic idea for the social sciences. We may start with the idea or with the fundamental phenomenon or with the ultimate manifestation of reason that mankind

is developing its powers to their highest possible unfolding, that men are achieving as complete mastery of external or physical nature and of internal or human nature as they are capable of. At times and in eras the development slows up for a while or even halts or recedes. But when we look at what humanity has achieved on both sides from primitive societies to the present, the continuity and the pervasiveness of the development of this twofold mastery over nature are outstanding.

Nor will it do to separate the two sides of civilization. The increasing development of mastery over external or physical nature, the harnessing of natural forces to man's use, has enabled the great populations of our metropolitan cities to live where otherwise there would be a swamp or desert waste. It enables the enormous populations of the world of today to subsist where otherwise they would starve or fall a prey to the elements. But behind the division of labor and the experiment and research and investigation that have made this possible there is the conquest of or at any rate the mastery over internal or human nature which has left men free to organize their activities and conduct experiment and research. Mark Twain said that Fenimore Cooper's "Leatherstocking Tales" ought to be called the Broken Twig Tales, because at the continually recurring crises in them someone always stepped upon a broken twig, and then the Iroquois were upon them. When men have to keep below the skyline and avoid stepping on broken twigs and be handy on the draw, there cannot be much division of labor or experiment or research. The postulates of civilized society—that men may assume that others will not commit intentional aggressions upon them, that they may assume that others who are pursuing some course of conduct will act with reasonable care not to cast an unreasonable risk of injury upon them, that those with whom they deal in the general intercourse of society will act in good faith and make good the rea-

sonable expectations which their promises or other conduct reasonably create, and that they may control reasonably for beneficial purposes what they have discovered and appropriated, what they have created by their own labor, and what they have acquired under the social and economic order—these presuppositions of civilized society, which are the conditions of the developing and maintaining of man's mastery over physical nature, are at the same time the measure of the extent of his mastery over internal nature. In one way or another, the social sciences have to do with the maintaining, furthering, and transmitting of inherited and acquired control over human nature and so ultimately of civilization.

Mr. Justice Holmes considered that we ought to test our theories of law by the bad man, the man who cared nothing for rights or duties or moral obligation but simply wanted to know what would happen to him if he did certain things or did not do certain other things. Happily, this type of bad man is not too common, or we should hardly be able to maintain the postulates of civilization. But Mr. Justice Holmes's bad man does have to be made to see that it is best for him to conform to those postulates or to be constrained to conform to them if he cannot be convinced. Moreover, there is in most of us, whether it is called original sin, or the Freudian wish, or the brute facts of human nature, a certain residuum of what might be called innate cussedness, the control of which is half of civilization. To control the bad man and the primitive tendencies of the ordinary man, and thus maintain civilization, is the task of social control.

I am not using that term here in the sense in which some economists have been using it, namely, to mean consciously planned guidance of economic processes through those who wield the force of politically organized society. I use it rather in the wider sense in which the term was first given currency

by Professor Ross, sometime a teacher in this institution, whom it was my good fortune to have for a colleague at Nebraska and to whom I owe my real start in the science of society. In that sense it means the control of each of us by the pressure of his fellow men, whether unconscious and involuntary or direct and purposive. It is this pressure, more and more organized and directed, which has established and maintains our mastery over human nature. The chief agencies of social control are the kin group, or in modern times the household, religion, morals, and law.

Among the peoples which have developed civilized societies from which we derive much of our social inheritance of today, the discipline of the kin group is the earliest and long the most effective agency of organized social control. But effective as it was within the group, competition of kin group with kin group, aggressions by individuals of one kin group upon those in another, and the regime of blood feud and private war to which demands for satisfaction or for vengeance gave rise retarded civilization and called for better means of maintaining the jural postulates of civilization than treaties between clans and devices for regulating the feud. Nevertheless, kin discipline long continued to be effective; and although groups larger than the household ceased to have other than a historical or social or sentimental significance, the household has remained, at least until very recently in our large cities, a primary agency of organized social control.

Religion, and in particular organized religion, shared the leadership in social control with kin-group discipline in antiquity and disputed and long shared the leadership with law, the instrument of politically organized society in the medieval and the modern world. Many of the postulates of civilized society were first formulated as religious precepts. Many legal institutions grew up by putting the force of politically organ-

ized society behind what had been religious teachings or religious duties and thus making of them legal doctrines and legal duties. A signal example is the postulate of good faith which is not merely at the foundation of the economic order but underlies most of the relations of everyday life. Today this is recognized, as we put it, as a jural postulate. But already in the earlier Middle Ages good faith was enforced as a duty of the pious Christian while the courts were ignoring many of its precepts, and the later law took the idea of giving it full effect from the law of the Church.

Morals is a term with double meaning. In one use it means systems of ethical custom—systems of organizing the general sentiment of what is done and what is not done, recognized in kin discipline, enforced by the ministers of organized religion, and often backed by the force of politically organized society and translated into law. In this sense, for which I have been in the habit of using the term morality, it means a body of customarily recognized precepts as to right and wrong existing in a time and place. In modern times, from a political standpoint we call it public opinion, and it is organized in all manner of voluntary associations—trade, professional, business, civic, social, and fraternal, each with its code or standards or traditions of what is done and what is not done and expelling the member who willfully fails to conform. This has always been an effective agency of social control and as it is exercised by all manner of voluntary associations is one growing in significance. In another sense, morals is used to mean a speculative, scientific development and systematizing of ethical principles, a body of ideal precepts where morality is a body of what the lawyer would call positive precepts—precepts generally recognized in some given society, not precepts pictured by the teacher of ethics as what ought to be recognized. The two affect each other and the combination of them has in the past made

strongly for civilization. Backed by religion or by law or by both, it is the strongest of the agencies of social control. But in and of itself it is capable of turning the law into new channels. Whenever a conflict arises between what is authoritatively laid down as law by the organs of politically organized society and what people generally feel as a matter of moral public opinion is right and just, the former will sooner or later give way.

Since the sixteenth century, law, the instrument of politically organized society, has been the paramount agency. Household discipline is exercised in subordination to it. Our grandfathers would have found it hard to believe that truancy and incorrigibility on the part of children, whose parents were living and perhaps zealous to use the rod for the moderate correction which the law allows to the parent, were matters for a court or judge. Supersession of discipline within the household by some sort of treatment under the supervision of a juvenile court has become a matter of course whenever a child gets out of hand and attracts the notice of the authorities. The circumstances of life in large cities seriously affect the constitution and functioning of the household and thus have accelerated the tendency of the household as a disciplinary organ to go the way of larger kin groups. Nor have the other agencies fared better. Organized religion—I am speaking now not of religion but of religious organizations—exercises its disciplinary power subject to judicial scrutiny and judicial overturning whenever invoked to expel a member in a way the courts deem arbitrary and unreasonable. So, too, with the voluntary associations which give organized backing to morality. Courts will pass on expulsions and disciplinary measures which involve interests in property and in advantageous relations, even social relations, if administered, as the courts see it, arbitrarily and contrary to natural justice. The law has taken over the whole domain either di-

rectly or by reviewing what is done by the other primary agencies. Perhaps it would be more accurate to say that politically organized society has taken over the whole domain, acting through law judicially administered and through administration. This raises the question what we mean by the term "law."

Few terms have been the subject of so much debate as this short word—a monosyllable in English, French, German, and Latin, the languages in which most of the debate has been carried on. A dialogue attributed to Plato discusses it and it has been defined and redefined ever since from many different standpoints. In the sense in which lawyers use it, it is applied to three quite different things: the regime of adjusting relations and ordering conduct by the systematic and orderly application of the force of a politically organized society; the body of authoritative guides to the determination of controversies, which, therefore, furnish guides to the conduct of those who seek to conform to the jural postulates of civilization and threats to those who do not; and the process of adjudication and administration in accordance with those guides to determination. The first is now called by jurists the legal order. The second has gone by the name of law since the classical Roman jurists. The third was called by Mr. Justice Cardozo the judicial process to which we now see we must add the administrative process on the side of the determining as distinguished from the directing function of administration. What unifies these three meanings is that the legal order maintained by the judicial and administrative processes in accordance with the body of authoritative grounds of or guides to determination of controversies is a highly specialized phase of social control, and the phase upon which society has put most of the burden in modern times.

But behind all the meanings of the term law and all the definitions which have been argued there is, or there was until

the present generation, an idea of system and order—of order and rule and principle and reason underlying the relations and the conduct of men, of individual conduct and official action measured by reason and principle—the idea in short that gives us warrant for speaking of the precepts of right conduct in international relations as international law. This idea is, indeed, a corollary of the postulates of life in civilized society.

In the English-speaking world we have carried this idea to its fullest development in our doctrine of the supremacy of law. In contrast to the idea which grew up in the Eastern Roman Empire and through Justinian's law books passed into the politics of continental Europe, which taught that the emperor was *legibus solutus*, exempt from the laws, and that the will of the emperor had the force of a law, the English common law started from a proposition that the king ruled under God and the law, and from the fourteenth century enforced the proposition that no person or official was above the law but whatever was done privately or officially was to be carried on reasonably, not arbitrarily, and entailed liability in ordinary legal proceedings in the ordinary courts if it exceeded the lawful authority of him who did it or the measure of reason imposed by law upon the exercise of that authority. It was not without a struggle between the courts and the crown in Tudor and Stuart England that this doctrine became established in modern England. In America, experience of the exercise of undifferentiated powers of government by the Privy Council and royal governors and their councils in colonial times led us to set up written constitutions as the first political act after independence and to put the separation of powers at the foundation and bills of rights in the forefront of those constitutions. If politically organized society had become the paramount agency of social control, it was to be a politically organized society operating according to law—one whose ministers and officials had their

powers defined by the law of the land and were held by that law to exercise their powers not to the measure of individual willfulness or arbitrary inclination but to the measure of reason.

Today in the rise of political absolutism all over the world this idea, by which our political life had been governed since independence, is under attack. An idea of the disappearance of law in an ideal society in which economic wants would be satisfied and there would be no need of adjusting relations nor of more than a simple ordering of conduct achieved through administrative orders has been urged in the English-speaking world as well as on the Continent. Partly it has been fostered by disillusionment after the last World War and the failure of democratic states set up over night with paper constitutions. Partly it has gone along with the development of autocratic governments, since law in any other sense than what the autocrat and his officials do is anathema to such a polity. Partly it is due to the rise to power of new elements in politically organized society which resent law as a check upon the absolute power to which consciously or unconsciously their leaders aspire. One form which this takes has been spoken of, namely, the doctrine of the disappearance of law, a doctrine originating with Karl Marx, preached by the late juristic and economic adviser of Soviet Russia, and now urged in many quarters. Another seeks to give a new content to the term law, teaching that the body of authoritative precepts applied by the judicial process is a myth or illusion or superstition and that law is whatever is done by the officials who wield the force of a politically organized society, and so what they do, however they do it, is law. Of these one can only say in the words of the Anglo-Saxon chronicle, "the more they do speak law the more they do unlaw." A third form seeks to merge the individual man in a group in which his rights and duties are no longer his but those of an organization. It is not a matter of his interests or claims or

demands, but of those of the group, to which he must look for securing them, and through which his contacts with the political organization and with his fellow men must take place. Such is the theory of the corporative state, the state in which the unit is not the individual man but the occupational group, a theory proclaimed by rising fascism and much preached in the past two decades. Little of what it set forth as its legal program has been carried out. Just as the idea of disappearance of law in Russia was followed by an autocracy which took seriously the proposition that there was to be nothing but administrative orders, the fascist idea of merging the individual legally in an occupational group succeeded in merging him politically in an absolute dictatorship.

Another type of idea, no less heartening to the autocrat, is in form philosophical rather than political or economic. It assumes the impossibility of a measure of values, even a practical one such as the law had long worked out. It teaches that there is a necessary and ineradicable contradiction as between morals and justice and law; that there is no way of reaching a balance between the general security and the individual life. Hence we must start with a postulated supreme political organization of society and derive all law therefrom. There are no such things as rights. They are but inferences from the applications of the force of politically organized society. So far as the threats of that organized society through those who determine them are enforced by those who exercise its powers of coercion, expectations arise which we call rights. It is significant that the part of the world where this doctrine was preached is also now ruled by a dictator.

Partly social control goes on through determinate, more or less deliberately set up, more or less consciously directed organized agencies, such as those of which I have been speaking. But partly and by no means least, it goes on through less determi-

nate or even indeterminate agencies, spontaneously arising and with little or no conscious direction. The latter, indeed, may have much to do, as it were behind the scenes, in the functioning of the former. For the background of the operation of the agencies of social control is likely to be the decisive factor. If we look only at the systems of determinate social control, we shall see only the surface. We must look also to the systems which give form and content to the background of operation of the determinate and consciously directed agencies.

If, on the whole, we may say that the succession among organized systems of social control has been kin discipline, religious organization, political organization, we may say with respect to the background that the succession has been home training, ethical custom, religion; not one successively replacing another, but one successively exerting a preponderant influence upon those before it. Behind these, however, culminating it may be in the nineteenth century, a new agency, namely, education, has been continually gaining in importance. Indeed, in the latter part of the last century there was something very like an attempt to substitute an educationally given background for that given by home training, ethical custom, and religion. From the Reformation to the end of the nineteenth century, organized education seemed to be taking over much of the role of organized religion in the past. I do not forget that education goes back in a sense to the beginnings of civilization. The primitive secret society in which the boy is raised into manhood and the men's house in which the acquired knowledge of the kin group is transmitted from generation to generation are among the oldest of human institutions. But these pass over on one side into political organization and on the other into religious organization. It is not an accident that the rise of political organization to paramountcy among the determinate agencies of social control coincides in point of time with the rise of organ-

ized education to paramountcy in the background. Each in the world of today is characteristically secular.

Great expectations as to the possibilities for civilization in systematized, properly directed education were nothing new. Socrates held that ignorance was the cause and root of the anti-social. Plato's Republic was pivoted upon a system of public education. But the putting of these ideas into practice and the elaboration of public education and reliance upon them as equal to the whole task of providing an adequate background for social control through politically organized society belong to the rationalism which followed the Reformation and in particular to the rationalism which was classical in the formative era of our American institutions.

As between the two agencies which have achieved paramountcy in the modern world, if law can maintain civilization and in a sense further it in that it sets and keeps free men's activities to increase human control over physical nature, it is rather education on which we rely to transmit civilization. But we should deceive ourselves grossly if we thought of that as its sole function. It is behind law in maintaining civilization and behind law in keeping free men's activities in research and experimentation and investigation. In education we have to do with an element in the background of social control. In part this background is a matter of habits or tendencies formed or acquired in our formative years and the systems which operate in the background have to do with giving direction to them. But beyond this a decisive element in our efforts to maintain, further, and transmit civilization is to be found in ideals, both generally received ideals and individual ideals of individual and social life and individual and social activities as they should be. In the workings of politically organized society, in what men do individually and collectively, men are guided whether consciously or often and in large part unconsciously by mental

pictures of things as it seems to them they ought to be. It is not the least task of education to shape these pictures, to enable us to understand them and criticize them, and thus to make them effective instruments of realizing the postulates of civilization through law and government.

To guide and restrain those who wield the force of a politically organized society is not the least task of morals and religion and education. If, as in the fashion of the moment, we hold that the only reality in the political order is force, force can control force only if it is a force imposing itself upon all other forces. Indeed, some define law in precisely that way. Laws, they tell us, are threats, and law is an aggregate of the threats made by those who are established or selected to make and enforce them in title of the political organization of society. The state—and that, says the realist, means the individual men who act in its name—has the touch of Midas. Everything that Midas touched became gold. Everything the officials do becomes law.

In this way of thinking, what has become the paramount agency of social control is something existing for its own sake. It is a phenomenon given us just as we are given the phenomena of physical nature. We cannot criticize the latter; we can only investigate them and seek to know them. So it is, we are told, with respect to the phenomenon of politically organized society. We cannot ascribe to the political organization of a society epithets such as good or bad, right or wrong, any more than we can ascribe them to the revolutions of the planets or the phases of the moon. It is as unscientific to ascribe them to the one as to the other. They are mere subjective opinions incapable of demonstration. It has been the strength of religion as a restraining agency that it needed no demonstration. It was the strength of morals as a restraining agency in the last century that it was believed capable of metaphysical demon-

stration, as proceeding by an unchallengeable logical process from an unchallengeable metaphysical fundamental. It was the strength of law from the twelfth to the seventeenth century that it was taken to have a foundation in religion which called for no demonstration. It was the strength of law in the seventeenth and eighteenth centuries that it rested upon morals, which were taken to be demonstrated by reason. It was the strength of law in the nineteenth century that along with morals it was a co-ordinate logical derivative from an unchallengeable metaphysically given fundamental. When demonstration is required of religion and yet it is held that such things cannot be demonstrated, when reason, we are told, does no more than offer us specious justifying of what we do as a result of the sort of deep-seated motivations which the past, I suspect, would have called original sin, when it is denied that metaphysics can give us unchallengeable fundamentals, religion goes by the board and morals and law are set at large. It is one of the paradoxes of the fashionable thought of today, which rejoices in paradoxes, that the so-called absolute thought of the immediate past, by which the officials and agents of politically organized society were held in check and led or constrained to rule measured by reason, led to liberty whereas the realist thinking of today, which has cast off the bonds of metaphysics and logic and given up conceptions and absolute ideas, leads in practice to establishing or tolerating absolutism in politics and in law.

I suspect that the explanation of this paradox is that the so-called realist thinking of today is quite as absolute, though in another way and while flattering itself that it is purely relativist, as was the thinking of yesterday. It begins with a proposition, assumed to be unchallengeable, that starting points are not arguable. It then postulates something, presupposes or assumes something, holds that something is incapable of proof and hence need not be inquired into further, and proceeds to

treat it as an absolutely given starting point. As it looks about it sees a world in which the rise of political absolutism is the most conspicuous phenomenon of the moment. As it sees force operating in the legal and political order, it ascribes to force a paramount significance. It takes the exercise of force by the officials of politically organized society as an absolutely given starting point. It tells that this exercise of force is reality and that all restraint upon it is pious wish or myth or superstition or false pretense. It is a much more dogmatic mode of thought than that of the past which it rejects as dogmatic. For the thought of the past held that starting points were demonstrable and so arguable and hence that individual interpretations of them were subject to criticism, whereas today the starting point is whatever one chooses to set up for himself, not arguable or demonstrable and hence not subject to criticism. Put in the form of political and juristic theory, such modes of thought cannot but be wonderfully heartening to the autocrats and dictators who have arisen in their train.

If we are to find reality or significance in phenomena, a very real phenomenon is the will to power, the faith of those who find themselves in possession of power that the exercise of that power as seems good to them is coincident with the general good and so justifies itself. This phenomenon is not confined to autocratic rulers of states. It has its counterpart in the conviction of the bureaucrat that his bureau and the public interest are synonymous. It has its fellow in the conviction of the administrative body set up to administer a particular statute or to regulate some particular field of enterprise, that the particular statute, or the regulation to the administrative official's own notion of how that enterprise should be conducted, is of such overriding importance that everything else must give way before what are taken to be the exigencies of enforcing the statute or regulating the enterprise. We had an example of

this not long since in the enforcement of the National Prohibition Act. Sincere, well-meaning officials clothed with wide powers as prohibition administrators conceived that the high purposes of that act were of such supreme importance that individual rights and constitutional guarantees and the ordinary decencies of investigation and determination were negligible in comparison. We have seen much of this same phenomenon in administrative enforcement of more than one statute and regulation of more than one field of enterprise throughout the English-speaking world today. Not merely with us but in England and in Australia we find a rising administrative absolutism holding that checks and balances and the separation of powers are nothing more than outmoded fashions of eighteenth-century thinking and cannot be suffered to hold back by asserting individual rights or constitutional guarantees or ideas of hearing both sides the zealous endeavors of administrative agencies to push us toward great social objectives in the forms in which they present themselves to the officials in charge.

I have said that in the Middle Ages law had a foundation in religion. In the earlier Middle Ages the Church made for universality and so for the uniformity and predictability in adjusting relations and in ordering conduct demanded by the economic order in a civilized society. It made for these things by enjoining and enforcing through penances and ecclesiastical discipline the courses of conduct called for by Christian morality. In the later Middle Ages, after the revived study of Roman law in the universities, when the legislation of Justinian was taken to be authoritative and binding upon Christendom as a continuation of the empire over which Constantine and Justinian had ruled, the theologian philosophers of the Church had to demonstrate the basis of authority of man-made laws. They had to reconcile the idea of the king or the state ruling by and under the law (the idea proclaimed by the fathers of the

Church) with the idea of a universal law of the universal empire, enacted by a Christian Roman emperor. The philosopher's solution of the apparent contradiction between the ideal of law as the ascertained justice and truth of the Creator and the ideal of law as the enactment of a Roman emperor was a theory of the eternal law, the reason of the divine wisdom governing the universe, and of a natural law, proceeding ultimately from God but immediately from human reason and governing the actions of men only. The enacted law, promulgated by sovereigns, was a mere recognition and declaration of the natural law, which was above all human authority.

Along with the Reformation came the decay of the relationally organized society of the Middle Ages. There was an era of social reorganization in which, as we have seen, the state acquired a paramount position as the agency of social control. In this era, too, religion shaped the ideal to which men adjusted relations and ordered conduct for at least three centuries to come.

In America, especially, the ideas of the Puritan Revolution came to be received as the basis of our polity. To the Puritan, as each man was an equal unit before God, so he should be before the state and the law. As John Robinson, the great preacher of the Pilgrims, put it, we are with one another not over one another. There is to be, he said, consociation, not subordination. An equal is to apply objectively the predetermined precept to an equal, not a superior to apply his will to the conduct of an inferior. The Puritan waged a constant and consistent warfare upon everything which seemed to him to involve subjection of one man to the arbitrary will of another. The exposition of the immemorial common-law rights of Englishmen in Sir Edward Coke's commentary on Magna Carta, appealed to him as the sort of system of pre-determined precepts, limiting the power of the magistrate to defined situations,

treated by a defined technique, by which alone one free and equal human being could be trusted or allowed to judge or coerce another. Hence he believed in what he called bills or declarations of liberties such as we now call bills of rights. Legal checks and balances and separation of powers had behind them this religious political theory.

Natural rights, as presupposed in the Declaration of Independence and taken for granted in our bills of rights, are not popular today. It has been said with much truth that the natural rights of man have shown that they could be as tyrannous as the divine right of kings. As they lost their ideal quality and became identified with the common-law rights of Englishmen and became a sort of positive natural rights in the last century, they could not maintain themselves. But what have we taken on in their place? Natural rights were the rights of all men guaranteed to all men. Our bills of rights guarantee them to persons not to citizens. Instead we now have, in the most persistently urged theory of the moment, the self-interest of a class, asserted and to be asserted as such, and valid to the extent that it can force itself upon others through the force of politically organized society. The one is an ethical theory, holding that what ought to be should be set up as what is. The other is a materialist theory, disclaiming all questions of ought to be and asserting that law is whatever is done officially and that a class which can control the force of politically organized society, using that force to its own ends, formulates those ends in what it calls rights and that is all there is to it. Such is the teaching which has been bearing fruit in another part of the world. It is not the teaching upon which American institutions were founded.

With the old props out from under the law, must we give up to ideas of unrestrained force guided only by the individual psychology of those who wield it or the material self-interest

of a class they represent and by which they are kept in power? The only prop that is in sight at the moment is education. Can organized public education do for social control through politically organized society what religion and morals backed by religion had done in our formative era?

As we had to ask what is meant by law, so we have to ask what is meant by education. Certainly in the present connection we do not mean a dogmatic handing out to the rising generation of authoritatively prescribed doctrine labeled truth. There has to be a struggle for free education as against those who wield or seek to wield the power of politically organized society as there has had to be a struggle for freedom of religion. State education is sought to be used for political ends as state religion has been. State control of one is no more to be tolerated than state control of the other.

If the machinery of social control is to operate to maintain and further civilization, men must be led to criticize intelligently their pictures or ideals of things as they ought to be, both as a whole and in detail. They will have such ideals and will be guided by them whether they acknowledge it or not. In a democratic polity, where everyone has a share in political power, every one's ideal of what is the end or purpose of government and of what ought to be done and how it ought to be done is of the first significance. Men must be led therefore to ask whence these pictures come, whence they get their outlines, whence they derive their details. They must be led to think about them, and to criticize the subject, the picture as a whole, the drawing, and the details. But where are they to get the materials for criticizing their ideals of the social order and of things as they should be? What is to guide them in revising, erasing, redrawing, and retouching? Actually men proceed on the basis of what they take to be facts. But these supposed facts are interpretations in the light of an experience which is

often narrow and one-sided. Where shall they find materials for shaping and giving content to ideals more compatible with the presuppositions of life in civilized society? Quite possibly there is no one answer. I am not here to preach to you the one thing needful. What I would urge is simply that here is the task of organized education in the whole scheme of social control.

Why do men's pictures of things as they are, and even more of things as they should be, fall short of what is called for by the presuppositions of civilized life? Why is there, very likely in entire good faith, a different picture behind the assured conviction of groups and classes and blocs and individual men that they are asserting conflicting claims in title of right and truth and justice or of the inevitable nature of things or that there are no demonstrable measures of value or valid ideals and so they may hold what the force they can command enables them to take? The epistemologist and the psychologist have ready answers which I will not challenge. But I suspect Socrates was right in attributing much of it to ignorance. One cause is that so many pictures of things as they are and as they ought to be are drawn from insufficient or defective information. Another is that too many are drawn on an insufficient and limited experience. Another is that often these pictures have been copied from those drawn by others who drew them for another time. We need to look at the information behind the pictures or ideals and broaden it. We must look into the experience behind them and deepen it and organize it and measure it, so far as we may, by all organized experience. Broadening of information, deepening of personal experience through comparing it with the experience of others and of other times, organizing and measuring of experience—these things are the work of education.

In organized education men are brought together. They

come from households and denominations and races and groups and classes and businesses and meet simply as fellow students. So, too, you will say in politics in a democratic polity where they participate as fellow citizens. But that participation, as democratic governments are conducted, involves strife and contest and factions and parties. In education, all the elements of the people may work side by side and even co-operate without requiring or imposing any distinctions save those which individual qualification for study necessarily imposes. However much, then, our educational institutions may at times and in places fall short of our picture of what they could do or should do, are they not the capital agency in our national and social life making for the furtherance of reason and restraint and direction of force by reason and so for the raising of human powers to their highest unfolding?

Women in the American University of the Future

AURELIA HENRY REINHARDT

President, Mills College



WHATEVER ELSE the American woman has been or has failed to be, she has not lacked energy to accomplish the task in hand nor the devotion to believe in its importance.

So late in world development came the discovery and colonization of the North American continent that our country, the United States of America, is deprived of mystery surrounding and glorifying its origin. We emerge from the pre-history of other peoples, we recite to our children the legends of other races, we possess from the Atlantic and Pacific no "backward and abysm of time" from which we have discovered the ascent and built a tower for our pride.

This accounts for much in our history. We have lived in a glass house. We have profited by what we saw through our own walls. We have been realists, self-conscious, but also conscientious, from Roanoke to Plymouth, from the James River to the Charles, grudgingly naming the landscape for royalty, and gladly signing the Mayflower Compact before we disembarked from the little vessel that was to become the Noah's Ark of democracy. Protestant Christianity, faith in our destiny, work beyond a modern's realization, hard, back-breaking, continuous, with no plow to break the land, nor beasts of burden to lift loads. We know the roster of passengers, the list of the luggage, the babes that were born, and the fifty men who died

during that first New England winter—half the population! No doctor, no nurse, no medicine, insufficient food.

But other ships with colonists kept coming, at first to “find God, not gold,” then for political freedoms, then for fortune, adventure, game, and on the government’s part a vast effort to build a new, continental England.

And the women? No dearth of them from Virginia to Plymouth: Mistress Forest, Anne Burras, Elizabeth Hard, Anna Dustin, Priscilla Alden, Anne Hutchinson, Margaret Brent, Elizabeth Pinckney—turning their wills and hands to every task in the wilderness. There was no kind of task, no phase of foundation, settlement, colonization, house and church building, farming, expansion, commerce, politics in which women did not eagerly take part.

Hunger and sickness in the settlements. Indians in the trackless forests. The ignorance of the newcomers as to primitive life and ways among the aborigines, the ignorance of the Indians as to the motives of settlers, the lack of faith on both sides—and there developed massacre, guerrilla warfare, French and English wars.

But out of this must come civilized life, for the colonists were civilized men and women. First the home. Then the church. Then the school. Women the builders and directors of the first. Men directors of the other two. Therefore, schools and colleges for the boy and the man. Harvard to insure a literate clergy. Yale to train men for the state. William and Mary to educate Virginia gentlemen.

Women at the creative center of colonial culture, where mother taught daughter and granddaughter the arts of nourishment, clothing, and health. No need for girls to have a school beyond hearth, threshold, and smokehouse for a good two hundred years. Were not women’s hands, head, and time full? Certainly.

The American woman had freedom to learn by doing for two amazing centuries of frontier experience before civilization in the new land became technical enough to give her the leisure and knowledge to yearn for laboratories and libraries.

Alexis de Tocqueville, in his *History of the American Republic* when it was scarcely a quarter century old, wrote of them, "If I were asked to what the singular prosperity and growing strength of the American people ought mainly to be attributed, I should reply—to the superiority of its women."

Seventeen seventy-six. A man named Daniel Boone crosses the Cumberland Gap. Rebecca is his wife's name, heroine of Powell Valley and early Kentucky. Her children are born in the wilderness. A man named Thomas Jefferson formulates a Declaration of Independence for the Colonies. No woman signs the document. On the western edge of the continent, of which the English colonists occupy a small northeastern section between the Atlantic and the Appalachians, a company of Jesuits land from Mexico. They begin a colonization of the Pacific Shore, but there is no woman among them.

In 1941, in this country, between the Atlantic and the Pacific, live 130,000,000 people. Of the women, some 600,000 are university students.

With a million and a half American men drafted for the organization and perfection of national defense; with nation, state, and community urged into formal programs of emergency education; with a publicity penetrating from the peninsula of Florida to the Aleutian Islands, a discussion of universities and of women may seem "immaterial and irrelevant." I believe it is not. American women at their best have developed an attitude toward life which demands that they must be ready for emergency.

But what right has one to surmise about women as students and as scholars when civilization in Orient and Occident are

being bombed from the earth? What does it matter when, why, what for, and how many women are now or may be associated with American universities when, currently with this symposium at Stanford University, century-old institutions in other lands are being reduced to heaps of rubble, when priceless libraries are consumed by flame, and women together with their brothers can enjoy no educational opportunity?

Many reasons might be quickly marshaled to testify that there *is* contemporary importance in the subject. The reply is as inclusive as the purpose of universities and the function of women in a democratic state. Because wars are spreading over the planet, destroying men and their achievements, increased effort must be made to assure the development of intelligence and strengthening of character and to utilize every influence making for stability, justice, creativity, and that kind of dwelling together and working together which is crammed into the dynamic monosyllable *peace*. Universities are such an influence. Women might be. When *peace* is brought to pass, reconciliation and reconstruction will be the result of intellectual effort, as well as of prayer and fasting.

With culture as with civilization, the uses of the *intellect* are concerned. With building as with destroying these group achievements, *women* are concerned, though it is astonishing how little until recently has been known of woman's part in human history. As archaeology, ethnology, anthropology have brought to light the distinctive contribution of primitive woman, research has turned its attention to women in classic times, in Reformation and Renaissance, in the settlement of the Americas. So, a literature begins to form—biologic, economic, educational. Still, almost everything remains to be done to establish the relationship of women, historically, either to the uses of the intellect or to the flowering of racial cultures and their stabilization into recognized civilizations.

When Oswald Spengler startled lay readers by his repudiation of history as figuratively a linear configuration or march of humanity, and re-defined history as a flowering of civilizations in various times and places, he had a good deal to say about women. At no point was he more provocative than in his chapter on "Destiny and Causality" where (p. 177) one reads, "The woman as mother is, and the man as warrior and politician makes history." Spengler did to historic scholars a service in reminding them how fractional is the knowledge and how questionable the accuracy of all historic writing before the twentieth century. In emphasizing the parochial limitation of most such narrative and in stressing the fact that life is not all battles or all elections, he draws three conclusions that bear on our subject: (1) The expression of humanity through the arts and sciences is as important as expression through military or political organization. (2) That man plants fields and builds cities is as important as his inventiveness in destruction. Energies so spent have improved the quality of life at all levels and clarified the functional nature of man's instincts and desires. (3) Wherever function is respected, there you must recognize woman and her potential values, biological, economic, and intellectual. From Thucydides to Gibbon, women have failed to write history. Today they begin. But a scanning of the men who were writers of history brings a reader to the conclusion that few of them *made* history. As warriors and statesmen Caesar and Gladstone are distinguished exceptions. One is tempted to suggest that if men could not write about the history they were *making*, the functional preoccupation of women from the beginning of time may be a more complete excuse for her failure to write about the history she *was*. Her silence may be proof, not of her lack of intellect, but that its recognition, encouragement, and memorializing was less important to her neighbors and her people than the carrying out of biologic and economic tasks.

Increasing recognition of women's creative contribution has been made as anthropology has thrown light on pre-history. Primitive woman, willy-nilly, responsible for bearing life, preserving it, and conserving it, made many discoveries. One job, to find caves for shelter, to plait palms into huts, was early architecture. Another, to plant seed and harvest a tiny crop was due to her originally accidental observation of seasonal growth and by millenniums of time preceded fenced farms. A third, to extract fiber and plait it, was the beginning of making thread and of weaving cloth, which took the place of her earlier millinery achievements through the preparation of animal skins for warmth. To dehydrate meat and fruits of the earth by fire or sun that they might feed the hungry in unproductive winter was an introduction to the varied and delectable methods of food refrigeration and preservation today. To imprison small wild animals and to let them grow mature for food in captivity was a far forerunner of today's cattle and meat business, as well as a prophecy for breeders of fine canines and equines. Primitive women did these things according to their geographic situation; necessity was the harsh mother of their many inventions, but inventions did come to pass.

When men were distant, defending families from human and brute enemies, women had time to look, to question, to guess, to try, to fail, to be patient, and to use hand, eye, ear, and mind, and often to succeed. What of science and of art may not grow out of these ingredients, if intellect is there? And why should intellect not be the portion of female as well as male in the human species?

From Robert Briffault's ethnological study called *The Mothers*, I quote one paragraph illustrating the tardy concern with women's minds or their viewpoint:

When we speak of human nature, we generally mean masculine human nature. We are in the habit of regarding the evolution of

humanity and of human ideas and sentiments as, in the main, products of the masculine mind. That assumption appears justified by a survey of human societies during historic times. The older speculations on social origins, such as the acute and learned discussions of Sir Henry Maine, had no other inductive basis than that afforded by classical history and the pictures of patriarchal society in the Old Testament; they assumed not only the invariability of human nature, but that human society itself had from its origin to the present day been constituted in essentially the same manner. It would indeed be difficult to conceive how notions and sentiments originating in the instincts of women could in those conditions have played any important part in the development of traditional heredity. Our knowledge of human origins, has, however, undergone a profound transformation within the last fifty years, and whatever the value of our present conclusions, they have been removed from the sphere of abstract speculation to that of inductive inference.

History, which thus became critical of its content and method only half a century ago, acknowledges through various writers the paucity of material on the specific contribution of women to culture or to civilization in any country. The material, growing greater in amount, is being made available in libraries, so that we can look for authoritative publications in this field of human endeavor which is as old as humanity itself. The place of war and statehood in Western civilization, two masculine professions, as elsewhere precludes an externally evident or obvious contribution of women in the fighting line, though the official work of Catherines of Russia and France, Isabella of Spain, Maria Theresa of Austro-Hungary, and Elizabeth and Victoria of England arrest one's attention. That women's contribution in war and statehood has always been auxiliary or subordinate is not true. Perhaps to deny the evidence of biology as to the identity of mental attributes in the sexes of animals bred for specific purposes may simplify some questions in the light of science. Still one may read that a weakness of the democratic state is the citizenship of women; that

economic democracy has not solved the question of what exactly to do with women; that educational opportunity for men and women alike has not proved a success, but encourages both sexes to want the same knothole through which to view the world beyond their yards. Women, to some writers, are the villains of history, especially of modern history—women are most to blame for the chaos into which contemporary peoples are plunged, whatever has been that people's race, ideology, governmental form, or military organization.

I am going to include a classic authority to the contrary, for even Plato, lover of men, who founded his academy that *men* might attain a wisdom larger than the market place, built his Republic on the assumption that women were capable of the responsibilities of guardians and must have identical education. The Greeks were less critical of women than these modern writers. In their symbolic mythology, a woman deity symbolized wisdom, intuition, profound knowledge, fit to be the eternal's messenger. Artemus, daughter of Zeus, sprang full-armed from her father's brain! To how many a gallant, needing aid, she came "crashing down the ridges of Olympus" to mend his shining sphere or to strengthen his wounded arm! To how many, fervently praying, she stooped, swift as lightning, and spoke softly so that only the mind of the praying one heard! Historically, we know the famed Aspasia, beautiful and clever, wife and ruler with Pericles; Hypatia of Alexandria, none lovelier, none more endowed with knowledge and understanding.

Women's story, as science and history begin to tell it, proves her creative intelligence and her capacity for loyalty. This era of world chaos finds her in every occupation, of national and international activity. But we must return to our subject, which is concerned with women in the universities of our land.

It is approximately one hundred years ago since three syn-

chronous opportunities came to American women. First, the founding of academies into which like that of Catherine Beecher, Emma Willard, and Mary Lyon, training was available for her in a curriculum much like the classic curriculum which had been enjoyed by men throughout the nation's history. These academies were later to become the women's colleges of today. A second opportunity was that in co-education. Oberlin College in 1833 made its courses of instruction available to women. This method of teaching was to be taken over eventually by practically all government high schools and universities. Her third opportunity was that of teaching and preparation for teaching. The normal schools taken from France and developed by Horace Mann became the avenue through which women were to enter in increasing numbers—the first profession outside the home into which they were widely welcomed.

This profession of teaching for women, concurrent with the development of the public school system of education and the demand for trained teachers, came to them with little opposition. The second profession which they made an effort to enter welcomed them not at all. Though women had been midwives and nurses since the dawn of history, they were not wanted as trained medical colleagues. There is something almost laughable, as well as tragic, in the story of Elizabeth Blackwood; typical of the story of hundreds of American women during the middle decades. After scores of letters and as many personal visits, this woman who was later to prove her brilliance was admitted to study in Geneva, New York. Her career in every detail proved the wisdom of her experiment. The success of women who followed her has been continued proof that women of adequate mental caliber, even as man, may become admirable physicians and surgeons. For decades, medical education for women was limited to foundations made in their behalf, the

first being Women's Medical College incorporated in Philadelphia in 1850. Forty years later, most medical students among women were admitted to co-educational medical schools. In 1895 the president of Western Reserve, writing of the slowness with which women were being welcomed into the professions, gave us the following statistics of three professions: doctors come first in number, then preachers and lawyers:

4,555 women doctors
1,235 women preachers
208 women lawyers

In the same year a study of professions in the Collegiate Alumnae, a national organization, showed in 1,800 members only 34 physicians, 6 lawyers, and a few preachers and journalists. One might comment that preaching and journalistic writing does not yet depend for its workers on specially certified men and women. A study of 8,000 college women, taken from a score of university lists, indicated that 5,000 would marry. Of the rest, three-eighths or 3,000 would be employed, and of these two-thirds as teachers. Of 8,000, then, only one-eighth would have occupations other than teaching.

Rachel Kent Fitz, a dozen years later, gives us an illuminating conclusion drawn from a careful study of two women's colleges: In 1907, among 3,800 graduates of two colleges, she found only 33 doctors, 7 lawyers, 2 ministers, 21 nurses, 50 writers, 5 actresses, 2 architects, while there were 100 in philanthropy and 25 in libraries.

Twelve years ago Thomas Woody of the University of Pennsylvania, published his comprehensive *History of the Education of Women in the United States*. He is insistent in his belief that discrimination must be made between the contribution of American women to the culture and civilization of this country and their formal education for making the best possible contribution. For example, I quote from him:

Even in teaching, the lower ranks of which were early opened to woman, there has been a marked tardiness and coldness of welcome to those who would enter the higher and better paid branches. Women are better and better trained. Antipathy can only be removed by time and the proof that women may accomplish research as well or better than men.

Woody believes that even the admission of women to universities depended "largely upon its necessity as a preparation for her vocational fitness."

To turn to makers rather than writers of educational history, we know that, beginning in 1884, M. Cary Thomas did a vigorous work in insisting on the university training for women who wished to be college teachers. By 1908, she could say, "The old untrained women teachers have disappeared from women's colleges [being supplanted by] ardent young women scholars who have qualified themselves by long years of graduate study for advanced teaching."

As to graduate study, it became available to women shortly before the turn of the last century. In 1892 the Commissioner of Education said that only 189 doctorates had previously been granted to women in the country. His report listed 42 institutions conferring advanced degrees in that one year to 312 men and 31 women. Ten years later 362 men and 42 women received recognition in one commencement season.

Moody claims that an examination of the projects in research in the graduate schools of this country over a period of thirty years shows as much originality in concept and in execution, as much initiative, as patient and industrious experiment among women as among men.

I learn from the materials in the files of the American Association of University Women at Washington, D.C., that the first fellowship was made available to women as early as 1884. This Association, for the six decades of its history, has done an excellent service for the higher education of women. Objec-

tively, practically, without sentimentality, it has encouraged an inter-alumnae association, an inter-institutional organization for the support of educational opportunities for women, in the most enlightened meaning of that phrase. Its membership is lay and professional. Its interest in standards has encouraged all institutions offering post-high-school instruction to women to better their programs. It has won the respect of educational accrediting organizations of every kind. It has developed a creative influence in its study of curriculum, methods, and philosophy of education at every level of our American endeavor. With admirable practicality it has endowed national and international fellowships for women, and has a lengthening role of distinguished scholars indebted to the American Association of University Women for their opportunities for research in a score of countries.

It was undoubtedly partly their enterprising, unselfish, and businesslike support of women students at the graduate level that made it possible for this statement to be made less than twenty years after their founding. In 1901, President Harper of Chicago asserted, "Women now being graduated with the Doctor's degree from our strongest institutions are, in almost every particular, as able and as strong as the men. If opportunity were offered, these women would show that they possess the qualifications demanded." Prejudice against women, not incompetence, stubbornly stood in the way of professional advancement. As tax-supported universities increased in number and in strength, and as economic need strengthened women's determination to profit by available avenues of training, women appeared in multiplying numbers. There is noticeable a disproportionate percentage of women accepted as students, and women accepted as colleagues. For example, in 1911, *The American Educational Review* noted that four universities—California, Maine, Cornell and the Massachusetts Institute of

Technology—had an aggregate of 1,258 instructors, of whom 25 were women. Farther west, in the same year, Ohio University had 41 per cent women instructors—a high percentage explained partly by the large division devoted to the preparation of teachers of all grades.

In the profession of college teachers, the women's colleges have generally divided appointments between men and women. I quote an available reference made in 1921 by the Association of University Professors on its 176 institutional members. Twenty-nine universities and colleges with 2,000 professors had two women—one in Harvard Medical School, one in Yale School of Education.

Fourteen colleges for women with 989 instructors counted more than 25 per cent of them men—exactly 251.

During the last ten years women in larger numbers are being invited into university lecture rooms and laboratories. Influential in bringing this about is less the realization of the capacities of women than the pressure of larger and larger numbers of well-trained women, the increase in the political authority of women in educational boards since gaining the suffrage, the scarcity of men due to the keen competition and higher salaries of scientific and administrative work outside the university, and within recent months the opportunities which come to women in war emergency.

Despite a growing improvement in the recognition of professional competency, there remains a difference in salary scales based not on competency but on sex. H. D. Kitson in *School and Society* makes available interesting statistics in this regard, stating the salary scale at important universities and colleges:

Promotion and rate of pay: Columbia women at 47 years

Chicago women at 53 years

Equal pay for equal work: 53% of co-educational institutions
73% women's colleges

The difference is astonishing, ranging from 10 per cent to 50 per cent, with an average of 18 per cent. Certain reasons for so distinct a difference in salary scale can be explained, even defended. The law of supply and demand still works its will. Families depend on men for support not only traditionally but actually. There is need of keeping men in college teaching, despite the fact that industry and business, as well as other professions, offer higher remuneration.

To give a more general summing up of the advance of women in the professions, we turn to the United States census. That of 1870 showed 525 women and 61,858 men practicing medicine in the United States. By 1890, 4,555 women and 100,248 men. In 1910, 9,015 women and 142,117 men. In 1920, 8,882 women and 141,125 men.

May we say in passing that since the day when Anne Hutchinson was exiled to Rhode Island from Massachusetts, because she wished to preach, women have not been welcome in the ministry. Quakers and Unitarians are most liberal in accepting women in the pulpit. There is today an increase in women among parish workers.

The study of law took greater patience and a longer time for women to gain entrance as students than medicine. The first medical degree, that of Elizabeth Blackwell, was awarded in 1848; whereas Ada Kepley of Illinois received her degree from the Union College of Law in Chicago in 1870, twenty-two years later. Yet, by 1920, there were 1,171 women in the law schools of the country, almost 200 receiving degrees that year.

Statistics are not literary material. But they give a picture of quantitative relationships that a long recital fails to do. From certain figures in *Statistical Abstracts of 1939*, and from the *Biennial Survey of Education, 1934-1936*, I want to read three statements for the value of their implications touching our subject:

FIGURES ON NUMBER OF TEACHERS, STUDENTS, AND DEGREES GRANTED MEN AND WOMEN

I. Professors and instructors					
	1900	1910	1920	1930	1934
Total	22,134	33,631	42,882	71,722	78,612
Men	18,343	28,477	34,111	55,861	61,299
Women	3,791	5,154	8,771	15,861	17,313
II. Students—Total	167,999	266,654	462,445	924,275	919,757
Men	128,055	185,379	295,828	576,477	570,514
Women	39,914	81,275	166,617	347,798	348,602
Students—Collegiate	104,098	174,213	341,082	753,827	507,052
Men	68,047	113,074	212,405	441,985	280,909
Women	36,051	61,139	128,677	311,842	226,143
Students—Graduate	5,831	9,370	15,612	47,255	69,772
Men	4,112	6,504	9,837	20,070	44,696
Women	1,719	2,866	5,775	18,185	25,076
Students—Professions	58,070	71,257	57,131	98,041	322,633
Men	55,926	65,569	53,295	92,786	240,786
Women	2,144	5,688	3,836	5,255	81,847
III. Degrees Conferred					
Baccalaureate	27,410	37,199	47,326	111,411	119,853
Men .....	.....	.....	31,544	70,006	76,786
Women .....	.....	.....	15,782	41,405	43,067
Graduate	1,952	2,541	4,853	16,832	20,442
Men	1,628	1,939	3,457	10,693	13,647
Women	324	602	1,396	6,139	6,839
Ph.D.	342	409	532	2,024	2,796
Men	322	365	439	1,692	.....
Women	20	44	93	332	.....

Today it cannot be contested that among the scholars in American universities some of the most excellent are women. Who did not grieve the passing of a great astronomer when the death of Miss Annie Cannon became known a few weeks ago? Dr. Annie J. Cannon, Harvard University, 1863-1941, a graduate of Wellesley in 1884, lived with stars most of her life. Her bibliography of variable stars contains 200,000 references. Her discoveries included 300 variable stars, 5 new stars, and 1 spectroscopic binary. Her catalogue of stellar spectra contains 272,150 items. It is my personal pleasure to remember Miss Cannon as one of the most natural and delightful of women.

Dr. Florence R. Sabin, bacteriologist, who is younger than Dr. Cannon by a decade, has retired from her Professorship of Histology at Johns Hopkins and her work in the Rockefeller Institute for Medical Research. Her brilliant findings of tubercular phenomena in blood and bone marrow are among the most important achievements of the first woman to be made president of the American Association of Anatomists.

Dr. Annie Louise MacLeod stands out as a scholar interested in her own research in her Chemistry Department at Vassar, in that of her colleagues, and in the development of her students. When she became convinced that certain problems in the chemistry of nutrition could be studied under a different environment, she removed to Syracuse where her studies and teaching have gone forward in the atmosphere she creates of inspiring good-fellowship and studentship.

Katherine Lenroot of the University of Wisconsin, now in the Department of Labor, is a scholar whose knowledge, highly successful in university teaching, has adjusted itself successfully to a government department. She possesses a capacity that includes what she knows and does, and gives still a sense of margin and of reserve.

But one should not pause to name heroic pioneers who are

passing, friendly colleagues of today, or the glad and competent scholars full of promise for a greater tomorrow. Physical scientists, life scientists, yes, but also anthropologist, classicist, author, statesman:

Dr. Margaret Mead, Ethnologist, American Museum of Natural History

Dr. Gisela M. A. Richter, Department of Greek and Roman Art in the Metropolitan Museum of New York

Dorothy Canfield, Scholar and Novelist, a doctor in her own right from Columbia University, Vermont's most beloved and creative citizen

Frances Perkins, now Cabinet member for Labor, student of Mt. Holyoke, of the University of Pennsylvania, of Columbia

Unreasonable to lengthen a list, is it not, when distinguished women are to be found in great numbers in all fields of contemporary life? The indications for the future seem clear.

In number of students, in variety of curriculum, and in toleration of women students, in increasing acceptance of women as colleagues within the university and in professions, the American university shows well statistically. There may still be tests whether an industrial vocational institution, a non-intellectual institution, can produce individuals of the quality of older institutions and adequate to these difficult times.

As Pater has quietly insisted, "The intellect demands completeness, centrality." We cannot call that complete which is founded on a skill of hand, or of eye, or of ear. Each student "must form himself as a particular being, seeking to attain . . . that general idea of which all mankind are constituents."

Women students as well as men deserve opportunity, to achieve this unapologetic, humane "completeness, centrality, . . ." discovering for themselves "that general idea of which all mankind are constituents."

So we close with a simple generalization. The university of the future must be liberal, knowing the universe itself is not geocentric. It must resist the temptation to take over the cult of power because we live in a power civilization, or the cult of numbers because we admire size. The university must become and remain intellectual, because to human beings of intellect democracy looks to solve the infinitely complex problems of a technical and industrial civilization. The university must accept women objectively as it accepts men, testing them in their capacity as individual human beings and judging them finally as persons capable of achievement.

Democracy needs leaders of mind and spirit among women as among men, as it needs men and women skilled of eye, ear, and hand. Women's capacity for skill was always taken for granted. It is no longer open to question; for there is full proof that women have capacity to learn, to teach, to carry on research, to achieve admirable results as scholars, scientists, humanists, artists. The task that is theirs in a rapidly altering world is more than ever inclusive, and more difficult; for intellectual participation once incidental becomes imperative. Intellectualism to an ever increasing degree must concern itself with the precise knowledge of nature and of the relations within the human family. Its application to human labor includes the unique and original burden of the primitive woman, the care of life.

Women in the university of the future have an assured place. What that place will be depends on which direction the American university takes. That it may become more intellectual and less technical is a national concern. That it demands the intellectual requirements of both men and women is imperative if the civilization of democracy is to reach its potential height. That the future will cease to question the capacity of women is certain. The future will ask proof of each individual woman

as it asks it of each individual man. Such identity of treatment will insure a fairer opportunity.

The woman of tomorrow must cease to apologize for the possession of intellect or talent. It should be unrelated to her opportunities for marriage and her happiness in marriage. In other words, as the college for women and the university admitting women come of age, they will show their maturity in permitting women to come of age as unself-consciously as their brothers, and enter into the inheritance of scholarship and intellectual achievement through the same means of application and experimentation as is permitted to the men of their country.

Some Aspects of the Biological Bases of Human Nature

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WHAT the universities can do for America or for mankind depends not alone on what the universities are and do but equally on the nature of the creature on which they attempt to operate. I am therefore to present some aspects of the nature of mankind, particularly those which may be called biological.

Man is a biological specimen. Nothing that he is or does is alien to biology. Biology is the science which deals with life; and the potentialities of life are more fully developed in man than in any other organisms. To be adequate, therefore, biological science must include all that is human. To characterize certain of man's attributes as biological expresses rather a way of looking at them than a distinction in kind. It means that we examine the attributes of man in the same way that we do those of other organisms.

When we do this, we find that the characteristics or attributes of men fall into a number of different categories. There are, first, attributes which human beings possess in mere virtue of the fact that they are human beings: attributes that are common to all mankind. Such are the physical properties of our bodies as materials: the facts that we have weight and extension and the like. Such is the structural plan of our bodies: we are vertebrates, we are mammals: and these facts cannot be altered.

But in most of their attributes and characteristics human beings may differ, do differ. Differences among human beings fall into two categories. On the one hand there are differences that are due to the diverse genetic constitutions with which men come into the world, or more specifically, that are due to the differences in the chromosomes which their cells contain. On the other hand there are differences between human beings that result from the different conditions under which they develop, the different experiences that they undergo. Here are included differences resulting from training, education, acquired knowledge.

The practice of life is concerned almost exclusively with those attributes in which men differ. It is therefore with these that we shall now concern ourselves.

Differences among human beings resulting from the conditions of living have from time immemorial been the chief concern of those interested in the welfare of mankind. Here are to be placed the differences due to wealth or poverty, to health or disease, to hygiene, to education, to the acquirement of knowledge. It is through these that the attributes of men are most readily and directly modified. And they affect all characteristics save the fundamental plans of bodily structure. To them have at times been attributed all differences among human beings.

But biological science has in its recent advances brought into clear light another class of differences among men that is of equal import. It has discovered that the diversities resulting from the different chromosomal materials with which men come into the world are as universal and as important for life as are those resulting from the different conditions under which men live and develop. It has shown that these chromosomal differences are indeed more fundamental, since it is they that provide the materials upon which education and experience

must work, and which largely determine what education and experience shall accomplish. Their role in life has been, and is, much misunderstood. We wish to examine and characterize that role. To do this effectively and in such a way as to avoid misunderstandings, we shall look at these materials and their activities just as if their observation presented no difficulties, and as if we knew nothing of the mystifying theories that have been attached to them.

Man begins life as a unicellular organism, as a single cell. The most important events of his life occur at that stage in his existence. It is then that he participates in the great lottery through which are distributed the endowments with which men are to work throughout their lives. It is then—and through this same lottery—that his personality is stamped in the type that it will maintain through all the vicissitudes of experience. As a unicellular organism he receives the store of things on which depend his later qualities and characteristics: his temperament, the nature of his emotional life, his powers and his weaknesses, both physical and mental. He receives those things in a distinctive combination that stamps his individuality, differentiating him from all other individuals.

And what is of immeasurable importance, practically and philosophically, these endowments come to him in palpable, visible form and grouping, so that they may be objectively examined, counted, portrayed; so that they are subject to experimental study. Their origin and their distribution can be traced, their methods of operation followed, their distinctive effects discovered. The processes by which these things occur are as concrete and palpable as the construction and running of an automobile. It is this fact that gives to the contribution of biological science on these matters its solidity and the certainty of its significance for the nature of man.

When these endowments are examined as palpable entities,

they appear as small, visible, elongated objects present in the nucleus of the unicellular creature. These visible objects, known as chromosomes, are present in definite number and definite simple arrangement. In the cell with which man begins life there are forty-eight of these chromosomes. Each chromosome is differentiated into many different parts or particles, having different effects; so that the number of different kinds of chromosomal materials is large—perhaps a thousand, or many thousands. The 48 chromosomes differ each from every other, and the thousand or more particles are diverse, each one from every other one. The chromosomes and their contained particles are active materials. They interact, and their interaction brings about the development of the individual, and plays a multitude of roles throughout life. Each chromosome and each of its materials divides repeatedly, so that every cell of the body contains the 48 chromosomes with all of their diverse materials. The nature and combination of the chromosomes and their materials in the cells of any individual decides in large measure the qualities and characteristics that he manifests in later life. By exact analysis and experiment it is demonstrated that to differences in the original stock of these materials is due a very large share of the later differences among individuals. It is demonstrated that to them are due differences in body form and structure, in facial features, in senses, in character and personality; in behavior; in power of adaptation to the conditions; in susceptibility to education and training; in capability of learning by experience. All qualities or characteristics or actions in which human beings may differ are influenced by the nature of the particles that make up the chromosomes. They constitute the endowment with which life is carried on.

Development and behavior, and the characteristics which they manifest or in which they result, are of course largely influenced by the conditions of existence—by those agencies which

are included in the other category of causes of differences in characteristics: by hygiene, education, experience, knowledge. There is no opposition—I had almost said no separation—between the work of the conditions of life and the work of the chromosomal materials. They operate on the same characteristics almost or quite throughout. It may be said soundly that any attributes that may be altered by education and experience may also be altered by differences in chromosomes, and that *most* attributes that can be altered by differences in chromosomes may likewise be altered by education and experience. The relation of the chromosomal endowment to the effects of experience is twofold. On the one hand, under the *same conditions* persons with different original endowments develop differently, behave differently. With the same education and experience, diverse chromosomal endowments yield different personalities, different courses of life and conduct. And, second, what is of particular importance, the power to profit by education and experience, the acquirement of skill and of knowledge, the capability of developing intellectual power, is dependent on the chromosomal endowment, and differs as the chromosomal endowment differs. The chromosomal endowment is original and primary; the effects of education and experience are secondary, depending on what the original endowment is.

These endowments—the chromosomes with their diverse materials—come to the individual by bodily transfer from his parents. The method by which they are distributed in the transfer from parents to offspring is of prodigious significance, for it is the most potent of all factors in fixing the fate of human beings. On it depends not only the distribution of types of bodily structure and physiological constitution but also that of powers, weaknesses, and aptitudes. And it brings about the astonishing result that every individual is unique: every individual begins life with a combination of endowments that

is different from that of every other. This is a fact of pre-eminent significance, the consequences of which for the understanding of the world and man are only beginning to be appreciated. To grasp this, certain of the concrete facts about this method of distribution need to be kept in mind. Parents, like other individuals, carry in their cells 48 chromosomes, with their included particles. Each parent contributes half of these—that is, 24 chromosomes—to each of his offspring, so that the child has again 48 chromosomes, 24 from one parent, 24 from the other.

Then comes a remarkable fact, of far-reaching significance. The 24 chromosomes that the child receives from one parent—the mother for example—form a complete set, adequate for all (or nearly all) the functions of life and development; adequate for the production of a complete individual, of a certain personality and character. And the other set of 24 chromosomes with their contained materials, which the new individual gets from his other parent, likewise contains all that is necessary for the development of a complete individual of a certain personality and character.

Thus the new individual—every individual—is double as to his endowment; as to his chromosomes and chromosomal particles. He carries two complete sets of the materials that lie at the foundation of life and development, each set containing all that is necessary for producing an individual. The 48 chromosomes and their contained materials are thus in pairs, one member of each pair derived from one parent, one member from the other.

Since the chromosomes of different individuals differ, the two sets, derived respectively from the mother and from the father, are diverse; they differ in their action. One set tends to produce an individual having certain characteristics; having a personality and character of a certain type. The other set

tends to produce an individual of a different type, with different characteristics. The personality that finally results is a blend, formed according to certain rules, a compromise, of these two differing tendencies. This doubleness gives rise to many of the ambiguities and contradictions of personality and of the relations of individuals to each other, particularly of the relations of parents to their children. For each individual carries within him, hidden, the basis for many characteristics which differ from, or are opposed to, those characteristics which he manifests. These hidden qualities may come to light in his children or in later descendants.

Just what characteristics the new individual shall manifest depends upon what *combination* he receives from his two parents. And this depends upon certain other relations. The parent individuals, like all others, are themselves double. They also have two sets of 24 chromosomes each, derived respectively from their two parents. In the parents, therefore, as in other individuals, the two sets of chromosomal endowments differ. Each chromosome of any pair differs from the other chromosome of that pair.

Each parent, we remember, contributes to the new individual one chromosome from each of his or her 24 pairs. It may be either one of the two differing chromosomes of any pair. It is as likely to be one as the other. In the new individual it meets a corresponding single chromosome from the other parent, to yield again a pair. This happens independently in all the 24 pairs.

Thus the new individual receives a new combination of the 48 chromosomes, a new combination of the thousand or more diverse particles which the chromosomes carry, a new combination of the potentialities that they embody. The number of different combinations producible thus from the 24 pairs in each of the two parents is prodigiously great. It runs into as-

tronomical figures. The two members of a single pair of chromosomes in each parent may differ in ten or a hundred or more respects. If they differed in but one respect, the number of different combinations thus producible from two differing parents is the number derived by raising 4 to the 24th power, or somewhat more than 652 thousand billions. And when we consider the thousand different separable chromosomal particles, in each pair of which there may be differences, we realize that the number of diverse combinations producible in the offspring is hardly to be expressed by a finite number. Any one and only one of this infinite number of diverse combinations may pass into any one of the offspring. Of the three or four children actually produced by a pair of parents, it is certain that no two will receive the same combination; no two will be alike in their endowments.

Further, we know that no two pairs of parents are alike in their chromosomal combinations. Each pair of parents would, if all the billions of possible combinations were realized—that is, if each pair of parents produced several billion offspring—give rise to a set of offspring different from every other pair. No single member of one of these great families would be like any member of the other family. No two individuals on earth, produced in this way, are alike in their chromosomal constitutions; no two are alike in their potentialities. We may say, indeed, that no two like individuals have ever been so produced in the history of mankind.

I recall a possibly irreverent remark by Albert J. Nock, to the effect that the Creator has never received adequate credit for the great feat of producing two billion human inhabitants of the earth, warranted no two alike. The method used is that which I have just recalled—the method of chromosomal distribution that I have tried to sketch.

The only way in which can be produced two individuals

that are alike in their chromosomes and in their potentialities is by the division, at an early stage of development, of a single individual into two or more, giving rise as it were to two (or more) examples of a single person. This happens at times in those rare and extraordinary biological phenomena that we call identical twins (or triplets or quadruplets or quintuplets). Save in these rare cases of the division of a single individual into two or more, every individual of mankind differs in his chromosomal combination, his genetic constitution, from every other, of the present or past generations.

The qualities, the powers, the weaknesses, of the developed individual—everything in which he differs from others—depend upon the combination that falls to him. Individuals with diverse combinations differ physically, mentally, temperamentally; they are diverse in personality. They behave differently in the same situations. With the same education and experience their behavior is diverse.

Some combinations are better fitted to meet the changing conditions of life than others, better adapted to the social conditions of the time than others. Some combinations are defective: the individuals to which they give rise are inferior. These are pregnant facts for the constitution of society.

As generations pass, new combinations are formed: combinations that have never before been made, yielding personalities that differ from any that have before existed. No combination is ever repeated. Every generation differs in the genetic constitution of *all* its individuals from every generation that has preceded it, so that the human stock is as it were made new at every generation.

To grasp some of the consequences of this redistribution of the chromosomal materials in each successive generation, consider the relation of the chromosomal constitutions of the present generation to those of some earlier generation—say, to those of

the great-grandparents.¹ Each person of the present generation is descended from eight great-grandparents. Each of these eight possessed 48 chromosomes, making 384 chromosomes in the set of eight. The 48 chromosomes of any individual of the present generation are a selection from the 384 chromosomes of the eight great-grandparents. Forty-eight chromosomes can be selected from 384, in the method of distribution that occurs, in such a number of different ways as is represented by the number 112 raised to the 24th power—an infinitely large number. Any one of this infinitely large number of combinations might occur in some great-grandchild. But of course only a very small number of these possible combinations can actually come to existence, in the small number of individuals of the present generation. Some of these individuals will have received fortunate combinations, bringing together in one person the best qualities of several or many diverse ancestors. Others receive unfortunate combinations, collecting together the bad qualities of many ancestors. Most of us receive a mixture of the poor and and the good, but each of us a different mixture.

The character and qualities of the later generation depend

¹ The problem here is: In how many different combinations may the individuals of a certain generation receive the chromosomes of a given ancestral generation? The problem must first be attacked for the chromosomes of one particular pair. Thus, among the eight great-grandparents there are sixteen chromosomes of pair 1. The individual of the present generation may receive any two of these, except that it may not receive two chromosomes from any one great-grandparent. The formula for the number of possible different combinations, C , is, if we let n be the number of individuals in the given ancestral generation:

$$C = 2n^2 - 2n$$

For all the 24 chromosome pairs together the total number of possible combinations is C^{24} .

This solution is for the case that each chromosome retains its individuality; it yields therefore the minimal number of combinations. This minimal number of possible combinations is greatly multiplied by the fact that interchanges may occur between the two chromosomes of any pair ("crossing over").

upon just which ones of the many possible combinations become embodied in individuals. This is partly determined by the selection of mates in the successive generations. This mate selection is one of the most important of biological activities, one most potent for weal or woe of the individual and of his descendants, and of the society which they constitute.

But after the mating selection is made there remains in every pair of individuals the possibility of producing offspring of any of the very great numbers of different combinations that I have sketched. Which of these combinations actually becomes embodied in individuals is now determined in a way that is similar to the drawing of number combinations in a lottery. It occurs in accordance with the rules of mathematical chance. Here neither science nor art nor any other activity of man is able to intervene. After mate selection has been made, the decision as to which of the many possible kinds of individuals shall be produced is exclusively a matter of mathematical chance. The great importance of the earlier mate selection lies in the fact that it sets limits to the kinds of combinations that can be made; it decides what kinds of combinations are indeed *possible*.

Looking back over the ground just traversed, we see that we have now reached a fundamental and pregnant generalization concerning the biological nature of man. Man is a creature whose personality and character—whose behavior under given conditions—whose powers of profiting by training, experience, and knowledge—depend upon the combination of chromosomal materials that he receives from his ancestors, in the way sketched. And all men differ in their chromosomal materials.

But what of the universal human characteristics that we mentioned at the beginning? To these have at time been attributed some of the worst troubles of mankind. Some tell us that wars must always continue because they are the expression of a universal human attribute. To what extent is it true that

men's characters and activities are dominated by such universal characteristics? And are such characteristics indeed unvarying and unalterable, so that the consequences to which they lead are always the same?

There are indeed universal characteristics that play important roles in our mental lives and in our behavior. All human beings are subject to pain and to fear and to hunger, as well as to other affections and urges. All human beings cling to life, avoid death: this is the very condition of continued existence. It is a manifestation of a more general characteristic that we may call self-assertiveness or even selfishness. We all seek the satisfaction of our own needs and desires; we all seek our own welfare: this, too, is a necessary condition for existence.

Correlated with self-assertiveness and to some degree contrasted with it is another universal characteristic. We all depend in some degree on other individuals. To some extent we seek the satisfaction of their needs as well as of our own: we have to some extent a sympathetic understanding of them. We seek the welfare not only of the single self but of the group to which we belong.

And it is here that the deepest human troubles arise. The universal urge to self-assertiveness, coupled with the sympathetic urge toward the welfare of certain others, leads to disagreements, to conflicts. To seek the welfare of a certain group is a universal characteristic. But *what is the group* that shall be included? Here is where variation arises. It is from the different answers to *that* question that the most serious troubles of men arise. The group whose welfare is sought always includes the self. Commonly it includes also certain others—one's own immediate circle—in whose welfare one feels an interest as great as in his own. The circle of sympathetic feeling and interest commonly extends to one's own family, then often in varying degrees to one's own class or his own nation. But it

doesn't extend to the rest of the world. The sympathetic imagination does not originally carry to great distances, nor cover great numbers nor unfamiliar conditions. Each group takes measures for its own advantage, disregarding the welfare of others.

The measures thus taken for the advantage of a particular group therefore come into conflict with measures taken by other groups. This failure of the sympathetic imagination, this lack of agreement as to the group that is entitled to advantage, becomes the greatest of all sources of trouble in human behavior. Its results range from mere personal "selfishness," through the criminality of individuals, through gangsterism and racketeering, through class oppression and class conflict, to extreme nationalism and war.

Illustrations of all this abound at the present time. The difficulties reach their culmination in the belief that is prevalent in many or most of the great groups of human beings, that *they* are better fitted or more worthy to carry on the work of life than other groups. Americans are certain that they were justified in taking this country away from the Indians. Italians were certain that they are more fit than were the Ethiopians to carry on life in Africa. The Japanese are certain that they are superior to all other races and rightly destined to rule the world. The same conviction animates the ruling class in Germany.

It is true, then, that certain universal characteristics play a great role in dominating human behavior and that they give rise to some of the worst of human troubles. But in even so brief a description as I have presented, one is forced to recognize and mention the fact that such universal characteristics differ in different individuals. Human beings are not all alike even in these universal characteristics. This is well illustrated by the very universal characteristic that causes most trouble—by self-assertiveness. In some human beings sympathy with fellow

nen is the ruling trait, in place of a desire to dominate them or to annihilate them. The relative strength of self-assertiveness, as compared with that other universal characteristic shown in some degree of sympathy with comrades, varies greatly in different individuals. Universal characteristics are by no means fixed and invariable. They vary in degree, they vary in details that are of the very greatest practical importance. Human beings differ in these respects as they do in other characteristics. From the fact that self-assertiveness and group-assertiveness are universal characteristics, it cannot therefore be concluded that they must in all cases manifest themselves in the same way. We need not conclude, as some have done, that such a manifestation of them as *war* is inevitable, that it can never be abolished. How universal characteristics shall operate is dependent, like other characteristics, on the chromosomal combinations present in the cells, and upon education and experience.

We may therefore reaffirm the general statement previously made, including in it the so-called universal characteristics as well as those that are not universal. Man is a creature whose personality and temperament and character—whose behavior under given conditions—depend upon the combination of chromosomal materials that he receives from his ancestors in the way that I have sketched. And all men differ in their chromosomal materials.

To appreciate the real significance of this generalization, we must look more penetratingly at what I have called the chromosomal materials. Following the usual custom, I have spoken of them as if they were something handed to the new individual: as if the new individual, the new personality, existed independently of them, and they were dealt out to him to work with. But this is a totally false picture. The personality has no existence apart from the chromosomal materials. Those materials are not something else than the personality. They are its very substance.

Here we must not be led astray by the fact that these elements of personality have a material existence, that they have certain of the properties that are traditionally ascribed to matter. Every property and diversity in human beings has, so far as science has been able to examine adequately into it, a palpable, potentially visible aspect; what we call a material aspect. The primal diversities of personality and character are not exceptions to this. They have, in the chromosomes, elements which possess certain objective, observable aspects and properties, chemical and physical, that render them amenable so far to scientific examination. But they are also elements which form a conscious individual—a person—that has sensations, emotions, thoughts, purposes. Their relation to consciousness, to mentality, is not less real than their material aspect. Each different combination of them constitutes, through development, a personality with distinctive characteristics and a separate consciousness: constitutes a unified subject, a self. The chromosomal particles within the young cell are ourselves at an early stage of development.

Recognition of these relations leads to far-reaching consequences, both philosophical and practical. The characteristics of individuals, as we have seen, depend in detail on the chromosomal combinations of which they are made. It is clear, therefore, that the determiners of what we become and of what we do are largely within ourselves. What a man shall do under given outer conditions is determined, not alone by those conditions, nor by his past experiences, but equally or in greater measure by the constitution of his own personality, his own self. Under the same outward conditions, or with equivalent experiences, individuals of different chromosomal constitutions develop differently, react differently, behave differently. This is a plain statement of objective fact. The individual is not controlled solely by conditions outside of himself, past or

present; he is largely self-determined. In dealing with human beings, whether in science or art, whether in medicine, in education, in economics or politics, always the specific nature, the genetic constitution, of the individuals requires to be taken into consideration if the measures taken are to be appropriate and adequate.

These considerations deeply affect the conception and the possibilities of the so-called sciences that deal with men: the social sciences. All human beings—with the rare exceptions of identical twins—are unique in their genetic constitutions. Every individual differs in that matter from every other. And it is certain, as we have seen, that development and behavior under given conditions depend on this genetic constitution; it is certain that individuals of diverse genetic constitutions may and do develop differently, behave differently under the same conditions. The so-called social sciences are therefore attempting to find general laws for unique individuals, each with his own method of action.

To these genetic causes for diversity of behavior under given conditions are of course to be added those resulting from differences in training, in education, in experience, in knowledge. The differences produced through these are not less real than those resulting from differences in the chromosomes. Persons with different chromosomal endowments differ, even though subjected to equivalent education and experience. It is equally true that persons with equivalent chromosomal endowments differ in character and behavior if subjected to different education and experiences. The two classes of determiners act together in an inextricable complex. But for the moment we speak only of differences due to diverse chromosomal endowments. Individuals that differ in chromosomal constitutions are differently affected by experiences that are equivalent: differently affected, for example, by the same knowledge. All

individuals possess diverse chromosomal constitutions. They therefore need not and do not act alike under the same conditions or with the same past experiences.

This means—contrary to what is often asserted to be the case—that the development and behavior of men are *not* subject to uniform and unvarying law. Each individual differs in his chromosomal or genetic constitution—as well as in his experiences—from every other; each is unique. And since both his development and his behavior depend on his genetic constitution and on his experiences, every individual may differ from every other in his responses to outer conditions; each is a law unto himself.

This situation furnishes the practical equivalent of free-will, of freedom of action, on the part of human beings. Yet it is without any breach of determinism, for determining factors are always present. But they are in the constitution of the individual himself. The individual man is free from the uniformity of fixed outer law, through determination by his own constitution. The action of the individual is unpredictable because he is unique. The situation discovered by biological investigation renders idle and out of date the old controversy of freedom versus determinism. There is determinism, since there exist chromosomal differences for all diversities of nature and action. But for the individual there is freedom, since the determining factors are in himself.

This situation is one that may give satisfaction to rebels against constraint by outer law, to those whose desire is to be free and to have an original and creative relation to the universe. To be—one's self—a unique and unparalleled creature is inspiring; it yields opportunities. And at the same time it is in unison with the positive discoveries of biological science.

This situation, too, frees present-day man from the domination of the past. The human race today is diverse from what

it was in the past. No single individual of the present time is like any individual of previous time. If a social experiment has failed in the past, if a reform has been unsuccessful, that does not show that it will fail in the present or future; for there is now a different race of man.²

A certain wise man has remarked that each man comes a novice to every successive period of his life. He must discover for himself the behavior which fits that new period; he cannot know it from his experiences in the past. This is true, too, of the human race. Its way of life is never settled, its problems never finally solved. Life is bound to continue to be fundamentally experimental, for each generation differs from all others. Each generation must discover for itself what is fitting for its life and organization.

This situation brings great opportunities, opportunities both for good and for evil. Since man is free, he can take the downward course as well as the upward one: and one can hardly resist the impression that just now he has taken the downward course. But, leaving that aside, it is obvious that the situation which I have sketched brings the possibility or certainty of disappointment to some high hopes. The troubles of mankind are sometimes attributed to the backward condition of the sciences of man, as compared with other sciences. The difficulties are to be met, it is held, by promoting the advance of the social sciences. These are to yield us fixed laws of human activity, com-

² The suggestion has been made that, although it is true that all individuals of any generation differ from those of other generations, nevertheless the average of human characteristics and behavior remains the same. This leaves out of account the very great influence and leadership of the rare individuals endowed with exceptionally good chromosomal combinations. History shows that one or a few such individuals may influence the behavior of men more than does the great mass of mediocre combinations. And it is by no means true that such exceptionally good combinations appear identically or in equivalent numbers or type in each generation.

parable to the laws of physics and astronomy. A popular book by a famous biologist asserts that "body and consciousness are subjected to natural laws more obscure than, but as inexorable as, the laws of the sidereal world." He urges the foundation of great institutes for the discovery of these inexorable laws. When in the progress of social science these laws are discovered, action in accord with them is to bring mankind out of its difficulties.

The situation that I have sketched tends to make one skeptical as to the promise of this program. The imperfection of the social sciences is not mere backwardness. It is fundamental. So far as human behavior depends upon the combination of chromosomes received by the individual, there can never be social sciences that yield fixed and certain laws of human behavior. The conception of uniform natural law is applicable in but a limited degree to the behavior of units that are unique, as are men.

To sum up: the fact that individuals are unique and consequently that their behavior is not subject to uniform laws; the fact that every generation differs from all preceding generations—these facts present difficulties for the sciences of man. They doubtless make possible many human troubles. But they mean also that human beings are not bound by ancient precedent, nor condemned to walk in the old ways. This means indeed that human life must continue always to be experimental: it means that the time will never come when social problems are finally settled. The results of social experiments made in earlier generations need not be valid for this generation, for this generation is made up of individuals that are new and diverse from those that before existed. The fact that each individual is a new creature with an original and untried relation to the world is one that *must be reckoned with*—whether for good or for evil.

The Unifíed Approach to Knowledge and Life

LEWIS MUMFORD



IN 1910 Henry Adams predicted that the civilization of the Western world would, by 1917 or thereabouts, pass into a new phase. Mankind would enter into possession of almost unlimited powers and might, perhaps because of these very powers, be overtaken by catastrophe. "Bombs educate vigorously," observed Adams, "and even wireless telegraphy or airships might require the reconstruction of society." In 1918 Oswald Spengler predicted that the period of liberalism and humanitarianism and social progress was coming to an end. He foresaw the rise and rule of Caesarism: a ruthless exploitation of men and machines for the purpose of exercising power, devoid of further human purpose.

One need not accept the dubious premises upon which these two predictions were based. But it is plain by now that their intuitive conclusions were mainly correct: the worst has almost happened. Our Western society is now in the midst of a possibly catastrophic change whose dimensions even the most unflinching observers scarcely dare to measure or describe. We face not merely the overthrow of this or that government or the conquest of this or that country: we are threatened rather by the forcible extermination of the very principles and beliefs upon which a co-operative world order has been slowly shaping itself.

The certainties upon which men's lives seemed founded during the nineteenth century, above all the certainty that this civilization would continue in the path of development men had then laid down, have crumbled. Today mankind finds itself trapped, as in an earthquake, and the very instruments upon which we justly prided ourselves—our sciences, our techniques, our administrative organization—now only add to our dangers. Like the crumbling walls and falling roofs and bursting water mains in a shaken city, our technical achievements complete the ruin caused by the upheaval itself. All the arts that seemed once to guarantee the co-operative union of mankind have become, in the hands of the new barbarian, a means of extending the domain of insensate power.

What has brought this situation about? By what mustering of mankind's latent resources can this civilization be rescued? By what changes in our beliefs and purposes and activities can we stay the processes of disintegration and establish the conditions that will favor the processes of life and growth in society? How shall we start our Western culture on a fresh cycle of development?

These questions, I submit, must underlie every rational discussion of the future of education. We can no more ignore them than St. Augustine could ignore the moral and political failures of the great Roman imperium when, on its wreckage, he attempted to lay down the foundations of the City of God. Nor must we make the mistake of blaming this vast secular change upon the errors and sins we have committed in the recent past: upon the first World War, upon the Treaty of Versailles, upon the recent unemployment and economic paralysis, upon the lethal unimaginativeness of the politicians and soldiers who governed the nontotalitarian countries. Those weaknesses were but symptoms. And it is only by examining the shaken foundations of our whole social structure, and by referring to

a much wider span of time, that we can understand why the so-called Century of Progress now threatens to usher in an era of regression.

There is something arbitrary, in the nature of things, in any summary statement of the character of the epoch that is now drawing to an end. But I think it can be described, without too great a distortion, as a period dominated by mechanism, militarism, and mammonism: a period during which the motives of domination and acquisition came gradually to displace other human interests or reduce their capacity for effective expression. By means of a superior technical equipment—the magnetic compass, the three-masted sailing ships, muskets and cannon, astronomical knowledge and maps—Western man originally conquered and colonized the planet as a whole. In an amazing outburst of physical energy and spiritual audacity, he expanded the area of arable land, appropriated the practical culture of primitive peoples, multiplied the stock of usable natural resources, utilized the machine to magnify human productivity, and in a single century tripled his own population.

This whole phase of Western civilization may be characterized as an era of expansion. Most of the new institutions of our society were founded on the premise of expansion and keyed to the need for expansion. In every field of activity men left their neighbors behind them and set forth boldly, more or less at random, to discover new territory, to stake out a claim to unearthed treasures, to blaze a new trail through the wilderness, to push forward toward a remoter horizon.

During this era of expansion, which lasted roughly from the sixteenth to the twentieth century, Western civilization became mechanically unified and socially disintegrated: it multiplied the new physical means of living and lost sight of the purposes and ends that make those means significant. The pursuit of power ceased to be a means of adding to the security and va-

riety of human life: it became an end in itself, attached to a disengaged fragment of the human personality. But because the power principle, pushing into every department of existence, seemed for a time to spread order and well-being on a scale man had never known before, the social and moral bases of this society were taken for granted.

This oversight was all the easier for the reason that the survivals and mutations of other cultures long remained active in the power economy. Not merely did the institutions of medieval society maintain their hold on large parts of daily life, but the heritage of a remoter classic past had been recovered; and during the eighteenth century a new humanitarian impulse, deeply akin to that which nurtured Christianity, temporarily softened the asperities of the machine. Furthermore, there was a deep-seated confusion, not confined to the popular mind, between mechanical improvements and social improvements. The optimism of the Victorian Age was based on the belief that the first in some sense guaranteed the second: the perfection of machines and the ennoblement of man seemed parts of a single process. Did not Mark Twain, a naïve mouthpiece of his age, couple the birth of the steam press, the steamship, and the railroad with the emergence of man "almost at his full stature at last"? Though mechanical invention did not always prove as beneficent to the workers, at first, as the utilitarians had proclaimed it, no one doubted that in time it would fulfill the rosiest predictions that its apologists had made.

Even for those who did not look upon the educative process as automatic, the prescription, in effect, was simple. If machines could be improved so easily, why not men? Indeed, why should man not be improved by the same methods—by disregarding as unreal, as inoperative, the human feelings and emotions, human sentiments and purposes and ideals: by treating man as a self-operating automaton? To create this paragon of

the mechanical age, it was necessary only to cast off the historic and social elements in his culture: to turn him loose from his home, to emancipate him from religion, to make him indifferent to art, to translate his dreams into stuff that could be fashioned by a machine, and instead of sublimating or etherealizing his exorbitant animal needs, to do just the opposite, that is, to materialize every manifestation of spirit. The crippled, lopsided creature that was left could then be hailed as "man almost at his full stature at last."

By a series of almost involuntary renunciations, the cult of the machine led to a disparagement of the rest of human culture. Labor-saving devices were treated as if they were, by nature, life-creating instruments. If only man improved machines, machines would inevitably improve man. So many people thought; and so many more acted, even when they did not think.

Superficially, this power culture conquered the world: conquered it and mechanically unified it. Throughout the planet, men spoke through the same kind of telephone; they read by the same kind of electric light; they shared the same news, sent over the same cables; and they viewed with pleasure the same black and white images on the motion-picture screen. Moreover, till the World War, the white peoples traveled and migrated freely over the earth. But this unity was not a genuinely inclusive one. Culturally, it was based on the dominance of Western man and Western modes of thought. But even within that framework it covered only those parts of life that submitted to mechanical routine or mechanical formulation. The intellectual understanding, the moral consensus, the scheme of values that were necessary, in human terms, to complete this mechanical conquest remained in a primitive stage; indeed, in certain departments the means of social co-operation were poorer in the twentieth century than in the seventeenth.

Take the matter of communication. For the last five centuries there has been a succession of bold mechanical improvements: the printed book, the universal postal service, the telegraph, the radio. But in the seventeenth century Latin, the common language of learned men, began to fall out of fashion; and though in the eighteenth century statesmen could still address each other in a common tongue, French, by the end of the nineteenth century even that vehicle of intercourse had dropped out of circulation. Precisely at the point where mechanical communication had become instantaneous, translation, with all its delays and misconceptions, took the place of direct intercourse. That blockage proved serious: the Babel of tongues now matches the older Babel of theological creeds. But unfortunately it is fairly typical. By mechanical invention the earth has been made one; but in human terms that unity has proved a barefaced fiction.

In other words, the real work of carrying our mechanical co-operations onto the human level still remains to be accomplished. This can be done only by an age that no longer looks upon the machine as an automatic instrument of salvation. Such an age must be ready to abandon the power-principle as the chief motive of existence and deliberately set itself to develop a balanced human culture.

Looking back upon the development of the machine, we can now see that there is both an inner reason and an outer cause for the crisis in which Western civilization now finds itself. The inner reason is due to the fact that the one-sided concentration on power has disrupted the human personality and has undernourished or paralyzed a large number of activities that are essential to the healthy development of the community. On the educational conclusions to be drawn from this fact and on the further steps we must take to overcome it, I propose to dwell at length in this paper. But the outer conditions

must not be overlooked; for they make the crisis more grave and our search for a balanced culture more pressing. The great underlying economic and social fact of our time is that the era of expansion is rapidly coming to an end; and we can no longer continue life on the old basis or hope to prosper by holding doggedly to institutions that were geared for expansion.

The facts about the tapering off of the era of expansion should be fairly obvious by now; but except for a remarkable prophetic analysis by John Stuart Mill, in Volume Two of his *Principles of Political Economy*, their implications have not been sufficiently appraised, and I regret that I can make only the sketchiest reference to them here. In brief, the expansion of Western man has had three aspects: an expansion of his territory, an expansion of the area of industrialism, and an expansion of population. The land surface of the globe has now been staked out and occupied: to achieve a better utilization of the land, a more harmonious distribution of groups and nations, the whole method of exploitation must be radically altered. The gross inequalities between continents, between peoples, between social classes, upon which our entire economic scheme was based, cannot now be maintained except by terrorism and brute force. If industries are to find new customers, it will not be by adding to the numbers of poor and backward peoples; by fostering the growth of an external or an internal proletariat: it can come about only by lifting the common living standard in every area. This means a shift from a producer's and exploiter's economy to a consumer's economy and, along with it, a readiness to diminish and even to forego profits for the sake of social security and well-being. We must prepare for the time when both population and industry will be mainly on a replacement basis: when the principle of continuous yield, as applied in agriculture and forestry, will supplant the reckless mining economy of the period of expansion.

Because of our slowness in interpreting this change, we have not yet developed rational means for meeting it. When people are confronted with a situation that defies their understanding and puts unbearable pressure upon them, they often seek to revert to a more primitive pattern. In the case of the totalitarian states, they have met the challenge of stabilization by reinstating the original terms of our conquest: by the complete mechanization and militarization of their politics for the purpose, once more, of unlimited expansion. To meet a world that has become intellectually incomprehensible, the totalitarians have a simple formula: they deny the value of rationality and put their faith in a magical system of salvation, under a leader who is also a god. Stabilization by regression is their neurotic response to the present crisis: to solve the social dilemmas of a power culture, the totalitarians propose simply to make power more unqualified. But we must remember Lord Acton's great generalization: All power corrupts, and absolute power corrupts absolutely. This applies to our civilization as a whole. The present reinstatement of the power theme by the Nazis may be interpreted, perhaps, as the last paroxysm of a dying civilization.

What, then, is the rational alternative? The rational alternative is for us to lay down the foundations for a new culture: one based upon the primacy of the human personality and the human community; the substitution of life-values for those of a power and profit economy; the reorganization of society as a whole toward the achievement of the best life possible. The guiding themes for the coming era cannot be derived from the needs and hopes of the era of expansion: we have to frame a whole new set of objectives in terms of balance, equilibrium, co-ordination, and cultivation, a many-sided organic development: above all, in terms of human balance, human co-ordination, human development. Power has become unruly be-

cause power alone has ruled. Many of the great individual advances of the past era remain to be done over again: this time, not for individual glory or gain, but for the benefit of the whole community. Many of our past dogmas must be abandoned; many of our past beliefs have become irrelevant; all of what is sound in our culture up to the present must be reworked into a more comprehensive and organic pattern. And the first place to start in this new instauration is the realm of knowledge. Let us consider our historic weaknesses here, before we formulate a regimen for education designed to correct them.

Now the first great change that marked the development of the power culture was that which led from the quest for unity to that for uniformity. In the *Summa Theologia*, the high point of the medieval synthesis, Thomas Aquinas had succeeded in the task that had for long constituted the principal effort of the Christian Church: to bring together in a single structure the disparate and often contradictory elements that had entered into the Christian order. The sources themselves were diverse; and the task of selection extremely difficult. Stoic law had to be accepted without stoic fatalism, Jewish morals without Jewish tribalism, Graeco-Arabic science without destroying the primacy of theology.

Such unities are never final, even when at the moment of achievement they seem inclusive; for they can be prolonged only by accepting their very relativity and incompleteness, and by continuing to add new elements while judiciously modifying or discarding the old. In other words, every synthesis must remain open or else, by the very fact of closing up, it will cease to unify the experience that has still to be included: if it remains outside history it will shortly become false to the new totality or, what is almost as bad, irrelevant. At no point is it possible to call a halt or say that a particular unification is final: one might as well try to preserve the shape of a fountain by freez-

ing the water in mid-air and turning off the further supply. The guardians of medieval culture made precisely this mistake: they failed to keep their system open or to formulate a method for orderly change. As a result, new perceptions, new insights, new generalizations were made outside the established provinces and were never successfully attached to the main structure.

The growth of capitalism and political absolutism in Western Europe brought to an end the efforts of an Aquinas or a Dante. The search for a common basis for thought and feeling and action, for a common medium that would unite the temporal with the eternal, the particular with the universal, gave way to the demand for external uniformity. Outwardly, the practice of uniformity has many points in common with the achievement of unity; and in relation to inner need they both spring out of the man's essential demand for law and order as a prerequisite for all other significant human activity. But, in practice, one is almost the diametric opposite of the other; for a unity is no real unity unless it is based on rational methods and free agreement, unless it recognizes and harmonizes and composes real differences: unless it retains within its order the variety and richness of life itself. Uniformity, in contrast, carries an element of compulsion: for the sake of an outward order, it will repress differences, or at all events, agree to ignore them.

By definition, the uniform is that which can be duplicated, multiplied, indefinitely repeated once the unit itself is established. In social life, uniformities first made their way into the Western scheme of life in the strict daily regimen of the monasteries; then in the growing demand for uniform coins, for uniform weights and measures, for uniform laws based on the Roman codes, for uniform military costumes. From the time of Frederick II of Sicily onward, the growth of despotism in Europe was accompanied by a strengthening of the cult of uni-

formity. There is no question about the efficacy of this principle in economizing energy: coins that are uniformly assayed and stamped are much easier to exchange than irregular bits of gold of uncertain quality, which must be weighed in each transaction; soldiers whose reflexes have been stiffened by drill are usually more reliable in action than more happy-go-lucky fellows whose behavior is less mechanical. Attention to uniformities had an enormous practical value in social life; and this was no less true in the realm of thought; for it was by paying attention to uniformities in the movements of the planets that the natural sciences acquired a method which reduced the complex welter of naïve experience to aspects and dimensions that could be measured. Within its restricted sphere, uniformity performs a human service, provided its restrictions are taken for what they really are: practical devices of the human intelligence, not the ultimate revelations of the absolute.

But there is something arbitrary and procrustean in this kind of efficiency; almost always it is purchased at a price. The uniformities of the despotic national state were achieved at the price of eliminating, not only local laws, but local customs and local liberties, whose cultivation had given a special local savor and tang to the landscape, the architecture, and the human personality in every region of Europe. Similarly, the uniformities of science were purchased by a disregard for man's complex, many-sided experience: by a contempt for his historic heritage, by a readiness to disparage, as purely subjective, that which could not be reduced to measure, and then to dismiss the subjective itself as unreal. Poetry, music, religion, painting, philosophy, all remained in existence; but they were steadily segregated, as disorderly, indeed as disreputable elements, in a sort of red-light district of the mind: a reminder of human infirmity rather than of human wisdom. Treated as social outcasts, these realms of the personality rapidly lost self-respect and re-

sponsibility; and they had relatively little influence, accordingly, over the workaday activities of decent citizens.

Though in the seventeenth century, and even later, a few philosophers still strove mightily for unity, the dominant fact of Western life was a continued fragmentation of activities, and a progressive widening of subjective differences, under the loose rule of tolerance. Following Descartes, the search for unity almost ceased; for he split the human personality into an automaton governed by the same physical laws that prevailed in the rest of nature and a soul that fell under the exclusive care of the Church, to whom all its historic and transcendental attributes were committed. That dualism was fatal, and especially fatal to education. Both in content and in method education ceased in the end to care for the human personality as a whole. Large areas of historic experience, like those of religion and ethics, dropped out of the secular curriculum, and the gap that they left was, as Newman predicted, divided up among economics, politics, and anthropology. Only in secluded spots, still under the tutelage of the Church—the University of Oxford, for instance—did the cultivation of the whole personality remain, preserving in an archaic form, with an obsolescent context, the old tradition of unity.

Against the dominant cult of uniformity, there were various strong reactions; but unfortunately they tended to take a backward path. Romanticism, in all its many phases, was a protest against uniformity: as protestantism in religion, as nationalism in politics, as land-pioneering and colonization in economic life, as anarchism, Bohemianism, or nihilism in individual relations. But romanticism, while it properly attempted to reinstate neglected parts of the personality and discarded elements in the human tradition, made the mistake of condemning out of hand the order and discipline and efficiency that had in fact been made possible by the widening conquests

of the physical sciences and the machine technics. In revenge for his being an outcast in the new mechanical world, the romantic sought to make the exponents of uniformity equally despised in his private world of passion, impulse, and fantasy. This only increased the gap between the two sides of the personality that were involved: it made it harder for them to come together in a common world. Instead of pursuing the search for unity along his own more organic lines, the romantic contented himself with evading the common social and intellectual obligations. Under the hardening crust of uniformity, romanticism presented the molten lava of the irrational and the irresponsible, seeking a fissure through which it might burst.

In the realm of education, the minor victories of romanticism, from Rousseau onward, were annulled by the radical changes that took place in the whole structure of knowledge. The most important of these was the rapidly increasing subdivision of the processes of intellectual production. This must be distinguished from the simple division of labor. Such a division, based on aptitudes and interests, is of course a necessary condition of human society: perhaps man's ancestors became human, among other reasons, precisely because of variations in native capacity that favored such a division. But the rational division of labor always assumes an underlying social objective and an intelligible common basis for action; and it is this basis and this objective that have increasingly disappeared.

The excuse usually offered for the minute subdivision of the processes of higher learning is that our knowledge today is too vast to be produced or absorbed by a single mind. But this has always been true. Even Aristotle, that prince of professors, did not command the entire body of his culture, though he added vastly to its domains. To make up for the increasing bulk of factual material, science in particular provides a system of shorthand notation, in the form of laws, or in the form of

symbolic devices, like maps in geography. In other realms of experience, the same kind of condensation is performed by philosophic systems and works of art. Thanks to these notations and symbols, those familiar with their use can see the view from the mountaintop without having to climb every foot of the way; thanks to works of art, the experience of a multitude of lives can be utilized within a single lifetime. These processes of condensation, generalization, and sampling must be counted as man's supreme labor-saving device.

Why, then, have we renounced the search for a unified approach to knowledge and life? Is it not because we have looked for unity in the wrong place? Once we give up the quest for unity at the center, in the activities of the personality, and the community, we must plainly abandon all hope for unity, even of the loosest kind, at the periphery, where facts and observations are overwhelming in their multiplicity, even if we restrict our search to the merest subdivision of any special field. What we need is not some all-embracing encyclopedia, which will be out of date at many points before it is even published: we require, rather, the invention of conceptual devices, and the perfection of a discipline, which will progressively transform our unrelated fragments of experience into an intelligible whole. The working out of these devices and the perfection of this discipline was the major preoccupation of the thinker from whom the underlying idea of this paper stems—Patrick Geddes. Others have been at work in the same domain. All these efforts must now be critically appraised, put to the test of daily use, and revised, modified, and elaborated.

The problem of unification is hopeless, then, only if one begins with a multitude of separate facts and separate academic disciplines. We cannot hope to create a coherent pattern of thought by laboriously picking up each fact and putting it into place: no lifetime is long enough to accomplish more than an

infinitesimal part of the task and, if it could be performed, such a static arrangement would be valueless. What we need, rather, is a magnetic field at the center which will continuously polarize every fragment that enters into the field: which will keep each part in dynamic relationship with the whole, because at the center, in the human agent himself, there is a conceptual core where all the aspects of experience draw together into a significant pattern. A magnet can perform in a moment, with a million particles of iron dust, what the most ant-like patience would not achieve in a month. The human personality, properly organized, properly disciplined, properly equipped, works in a similar fashion. For the fragmentary man the world outside the narrow domain he has mastered is a shifting chaos of fragments: for the whole man every part of experience has a place; even what is unknown or undiscovered, or what lies beyond his personal compass, exists in an orderly relationship, like the undiscovered elements in Mendelyev's original Periodic Table.

Now it happens that there is a close historic connection between the unrelated production of knowledge and the unrelated production of material goods: the present crisis in our civilization arises partly out of serious maladjustments in both departments. Both exhibit a growing rationalization within the process of production and a growing irrationality, marked by moral irresponsibility and social ineffectiveness, in the disposition of the product. Fundamentally, the factory and the university have accepted the same premise: the belief that fragments of mechanical production or fragments of knowledge, are real, are significant, and are valuable in themselves: to produce them and accumulate them is a profitable life occupation. This is the bias of an acquisitive society: a natural compensation, perhaps, for long centuries of intellectual sterility and material want. Filled with admiration for the new technical proc-

esses of production, we have, however, lost sight of the social destination of the goods themselves. When a factory goes on producing without finding an outlet, the result is a surplus of undisposable stock: a prelude to unemployment and perhaps bankruptcy. This has a parallel in our intellectual life. There is the same failure to translate technical advances into social values, and orderly methods of production into a planful and purposive scheme of living.

To sum up: the age of expansion widened the area of objective uniformities, both in the sciences and in many departments of social life; and by so doing it put almost immeasurable powers into the hands of modern man. But by concentrating on this element of power, we lost connections with other important human needs; so that beneath the surface uniformities there was an increasing area of subjective disruption, and beneath the surface manifestations of power there were, from the standpoint of the whole personality, indications of disorientation and rebellious conflict. The split personality, rational in its special field, open to irrationality in other departments, disciplined on the mechanical side but undisciplined and emotionally underdeveloped, became the characteristic human product of this culture. Partly because of the failure to make a synthesis of our growing body of knowledge and a unity of our lives, we are threatened with further disintegration.

At this point, we must not make the mistake of believing that our difficulties will be solved by more education: that the cry of the masses for salvation will be attained by inducing larger numbers to remain in high school or to pass through college, or by elaborating our physical plant and equipment and adding to the number of laboratories and libraries and courses. For more education of the kind we have laboriously perfected during the last seventy-five years will only widen the area of our difficulties. With a few struggling exceptions, our

schools and universities are mirrors of the very condition we must overcome. For fear of losing authority, the specialist dares not step out of his narrow compartment; for fear of being challenged on unfamiliar territory, he refuses to break down the boundary lines that habit and convenience have erected between various realms of discourse; for fear of losing time on his own job, he refuses to concern himself with the difficult task of coupling and interconnection. Nor is there merit in the suggestion for a holiday in the physical sciences and mechanical invention: that is a crude empirical scheme for temporarily overcoming the inherent lack of balance and relationship between the various spheres of organized knowledge.

What is needed is a far more radical change: a change in method, direction, tempo, and purpose. Our problem is not, as some educators once thought, to adjust our education to the needs of a changing world: the problem is equally that of adjusting a changing world to the basic needs of education: meaning by education the harmonious culture of the entire personality, operating within the medium of a common culture, and within the frame of a going community. In short, we must think out a rational alternative to the incoherent uniformities of the past! We must provide a progressive and humane alternative to the regimentation that offers its so-called "new order" today. In conceiving "the scope and nature of university education" in the days to come, we must hold that "its matter must not be admitted into the mind passively, as so much acquirement, but must be mastered and appropriated as a system consisting of parts, related one to the other, and interpretative of one another and the unity of a whole." Our aim will be that which Leibnitz thought he discerned in the universe itself: the achievement of the maximum variety compatible with the maintenance of order. This, at least, must be our aim if we recognize the imminent end of the period of un-

limited power, unlimited acquisition, and unlimited expansion; and if we seek to lay the foundations for a more organic order, capable of more fully sustaining the life of the personality and the community.

Now beneath every system of education there are certain metaphysical assumptions as to the nature of the universe and the condition of man. Some of those who have talked in recent years about the need for a unified approach to knowledge have coupled this with a tacit demand to return to a defunct social structure and to a metaphysics that would deny the validity of historic experience. Since I do not share those views, without many strict reservations, I must make more explicit the underlying beliefs upon which the present outline rests.

The first of these is a reversal of the conventional order of modern thought, which looks upon the physical universe as basic and ultimate, and the facts of human society as entirely derivative. This metaphysics arose in the sixteenth century, through the fact that uniformities and mathematical certainties were first established in the physical sciences and gave man a vivid new world picture, which displaced that in which Heaven and God had been at the center. But man is not born into a bare physical universe; that is an abstraction which was first achieved, perhaps, by the Ionian philosophers. Man is born into a world of human values, human purposes, and human instruments: these values, purposes, and instruments condition all his other experiences; indeed without them he would live only on the level of brute sense and appetite. Every attempt to describe a world without human society presupposes the artifacts of human society as an integral part of the description.

By social artifice man has created a life that is not strictly dependent upon his biological state or his immediate environment. This is the realm of history, if one means by history,

not simply the succession of recorded events, but the entire sum of man's available cultural heritage. We can approach nature only through the medium of human culture: not alone through our practical tools, but through language and logic and number. In the development of all these social instrumentalities our bodily processes and our organic aptitudes and our organized social responses to the challenges of life itself have played a part. The accumulations of culture form the topsoil and humus in which the higher life of man, distinguished here from all other brute creation, has flourished. Let the historic roots of our culture be plowed up, let the dust-storms scatter the loose soil, and what is left is a bare surface of nonhistoric experience which will not sustain human life or thought.

The metaphysics which put the physical universe first avoided reference to the natural history of the self and society. Hence it denied the importance of time except as a succession of physical events: there was no place in its scheme for the accumulations of time, for a past enregistered in memory and so constantly present, preserved for the community at large in its institutions. The isolated body, the abstracted piece of matter, was supposed, as Whitehead has put it, "to be conceived fully and adequately within the present moment." If we begin our inquiry with the facts of society, we find that memory, in all its biological and social and personal forms, is what chiefly distinguishes man from a well-contrived automaton. For a metaphysics that puts society first, history is the groundwork of specifically human activity. Unless one treats the making of history as the essential process of human life, no single event or action makes sense. For history brings about a social partnership in time which complements and completes the manifold co-operations in space by means of which society flourishes.

Here, then, are my two fundamental assumptions: first, the facts of personality and the institutions of society are basic to

all other human experience; and, second, man is a history-making animal, who lives in the three-dimensional world of the past, the present, and the possible, or, if you will, in a world of the real, the realizing, and the realizable.

What follows should be fairly plain: the deliberate culture of the personality and the community is basic to every other kind of study; and the revitalization of history becomes accordingly an essential task of education. Let me deal with the second matter first. This is not simply a matter of adding history, as a prefatory calendar of events, to the existing body of knowledge, though history as organized record of course has a place in every curriculum. But it is more emphatically a matter of searching for the relevant past in every department of learning as the necessary context of an understandable present. The watchword of the political revolutionaries of the eighteenth century was: The past has nothing to teach us; history is the record of superstitions, frauds, and lies. But the actions of these sanguine reformers were usually more benign than their slogans. They were not so innocent of historic example as to deny that honesty was better than fraud. Only in our age have the final consequences of their anti-historic nihilism shown themselves.

Many of us remember the time when, in the name of the so-called New History, it became fashionable to say that only modern history was important. Out of date was out of mind. Never was a shallower notion propounded to the world. For no generation can begin from scratch; when it does, it becomes a victim of the immediate past, and in the very act of throwing off history it submits with helpless docility to a small segment of it. Had our contemporaries carried with them a living consciousness of the Graeco-Roman world they would not have been so unprepared to understand the symptoms of their own disintegration; had our postwar interpreters of poli-

tics and diplomacy related their findings to the centuries-old background of the World War, they would not have foisted on our generation the juvenile belief that all our difficulties began with the Treaty of Versailles.

What has been weak, in fact, in the development of human culture has been the imperfection of our instruments of record and interpretation. The destructive forces of nature and man tend blindly to wipe out a great part of the heritage before it has been assimilated in adequate symbolic form. So far from being overwhelmed by the accumulations of history, the fact is that mankind as a whole has never carried enough of its history along with it, in forms that permitted reflective criticism, rational selection, and renewed employment. By lengthening one's historical perspective one becomes able to throw off the partialities and relativities of one's immediate society: likewise, by facing the totality of human experience, one includes elements that the fashion or habit of a particular period may have arbitrarily rejected: archaic elements, primitive elements, irrational elements, that are often overlooked by the wise in their too narrow wisdom. Did not modern medicine drastically revise its practice in part through the recovery of Hippocrates? Did not Freud receive a special impetus from the dream book of Artemidorus Daldianus, which preserved a form of human lore transmitted otherwise only through superstitious peasants and ignorant servant girls? In this sense history is a reservoir of human creativeness. And without the perpetual rediscovery and reinterpretation of history, without free access to that reservoir, human life would be but a trickle of brackish water in a desert. That is why a burning of the books, in modern Germany as in ancient China, is the first major act of the barbarians' attack on civilization.

But history has another side, which is usually neglected: it is the domain of the possible, the starting point of the ideal. Since

Aristotle, the concept of the ideal has largely dropped out of scientific discourse, and because of the general influence of our practical and technical culture, it has dropped equally out of human life. When social scientists, for example, approach the future, they do so circumspectly in appearance—but in fact far too rashly—with the aid of statistical charts, in which a broken line, carrying forward the curve of past tendencies, is supposed to indicate the future path of development. But this statistical future, though often useful for limited practical guidance, has only a limited bearing. The real future is no mechanical continuation of the present: from moment to moment the line of the past may be altered by new factors operating from both inside and outside the human personality.

For every potentiality that matures in the individual a score of others must be neglected. But at any time, under the influence of need or desire or memory, one or another fresh element may be brought into play. It is the same in society at large. The selection of potentialities and the projection of ideal goals, is, with reference to the future, the counterpart of an intelligent commerce with the past. No life is veritably purposive unless it exhibits prospective reference as a constant factor in its behavior. The neglect of the ideal leads only to the covert practice of giving to the present an ideal significance which it does not possess.

By means of history and Utopia, then, the human personality partly transcends the limitations of its time, its place, and its social order. Through them, the potential and the actual constantly interplay.

This doctrine takes us a long way from current practice. In the recent past, we have shied away from the normative aspects of education; and our failure here has not merely brought about a distrust of the imagination on almost every plane but has in turn lessened our capacity to anticipate or to control the

future. Lacking an articulate system of ideals, our choices are inevitably chaotic, or unprincipled, to use an old-fashioned word that needs to be restored to an honorable post; that is, without direction and without ultimate moral and social reference. One of the remedies for this situation is a systematic renewal of the fields of esthetics, ethics, and religion, the great domains of ideal values. Their cultivation at every level, in reflection and in practice, in doctrine and in action, is essential to the balanced development of the human personality. An individual who has not yet entered into these realms has not yet reached the full human estate. Such cultivation, moreover, apart from its valuable inner discipline, will perhaps help bring back into our practical activities the powers of vision, of imaginative anticipation, and of ideal reference often so conspicuously absent.

Though the personal and the communal are primary, in the metaphysics I have been roughly outlining, one must assume that there is no break in continuity between the social, the biological, and the physical aspects of existence: they are organically related, and can be separated only as a convenience of thought. The doctrine of emergence, as developed by Lloyd Morgan, is sufficient to account for the radical qualitative difference that may be observed as one passes from one aspect of existence or experience to another. No matter at what level of abstraction one may approach a particular event, the meaningful context involves ultimately every other level. A partial report may of course be true as far as it goes: limitations of time and practice often make it imperative to let the part stand for the whole. But truths, as Leibnitz well observed, have degrees of adequacy as well as degrees of certainty; and only a method of thinking that acknowledges the interrelatedness of all the fields of thought and experience can give an adequate orientation to any part. The ground plan of the whole must modify the structure of the individual truth.

This doctrine daily becomes more plain in practice, even though it is still too much neglected in theory. For the physician who pursues his medicine far enough will eventually come face to face with problems of psychology, social organization, economics, and even religion; while the engineer who sees behind his slide rule and his drafting table will eventually intersect the path of the physician. So with every other well-developed interest. The great creative efflorescence of painting during the Renaissance was associated with the systematic research, by artists, into the physical laws of perspective and the anatomy of the human body, with increased devotion to the problems of mechanical invention and architectural construction. In our day, professional training has discouraged this deliberate ramification of knowledge and experience. Success has come mainly to the specialist, trained like a race horse with blinkers, ridden to victory on condition that he follows his lane on the track and pays no attention to what takes place on either side of him. This performance may win trophies and prizes; it may give intense satisfaction to the horse, the rider, the owner, the spectators; but it takes for granted the merits of the sport itself. And it is the merits of the sport, with respect either to adequate truth or effective social use, that I make bold here and now to challenge.

What I suggest is that specialized knowledge must be treated as only a part of organized human experience and that it must be directly related, from the start, to every other aspect of the human personality. Instead of overstressing subject matter and forgetting relationships, we must stress orientation, and make it possible for the student to find his way from any given starting point to every other relevant part of human experience. There have always been a few inspired teachers who have been at home in every part of their world and who have been as fully aware of their historic relationships and their social re-

sponsibilities as of their immediate professional quests: Joseph Henry in physics and William Osler in medicine were classic examples. But we can no longer leave to such accidental aids the processes of unification and interrelation; we can no longer leave to random pressure and interests matters that call for discipline, plan, and rational organization.

To define and articulate the common world of experience, shared by each and all of the arts and sciences, is one of the central tasks of philosophy; and to be familiar, in greater or less degree, with every part of it, so that one may pass freely back and forth between the objective and the subjective aspects, between the sciences and the ideologies, between active participation and contemplative withdrawal, is the essential characteristic of the fully educated man. One must understand the whole circle of experience if one is to cultivate properly any part of it. There is, I believe, only one effective means by which these ends can be accomplished; and that is by the institution of a common curriculum. One need not overlook the fact that intense interests must be recognized, special talents encouraged, and exacting professional requirements adequately met; but as both the prelude and accompaniment to these modes of emphasis, it is important to reinstate the humanistic notion of a common subject matter and a common discipline, at every stage in the educational program.

The psychological reasons for this common curriculum are no less significant than its social grounds. Dr. C. G. Jung has wisely suggested that it is important, in the interests of personal balance, to cultivate one's weaker aptitudes. This means that the contemplative man should have some share of practical responsibility, that the imaginative artist should be familiar with the scientific method, that the future organizer of great enterprises should familiarize himself with the theological conception of the special sinfulness of pride. In the past

phase of culture the cultivation of personality and community was regarded as secondary and left to the end: human values remained as survivals of nonmechanical cultures or as accidental by-products of the machine itself. For us, on the other hand, the problem of personality has become central: as important to our society as it was to the disintegrating classic world. Our common subject matter must be human life, in all its historic manifestations: our common goal will be a maturing human personality, at home in a developing community.

Though for the sake of clarity I have emphasized the role of organized knowledge in this new orientation, I should be untrue to the philosophy I have been expounding if I assigned the entire task of integration to the realm of formal education. Far from it. Dr. Robert Maynard Hutchins has well observed that it is a modern heresy to hold "that all education is formal education and that formal education must assume the total responsibility for the full development of the individual." The Greek notion, he adds, "that the city educates the man, has been forgotten." Unfortunately, the Greek notion seems also to be forgotten by Dr. Hutchins himself; for it is obvious that our cities, as at present constituted, are incapable of furthering a well-balanced life, at every stage of human growth. Hence the reordering of the city and the region become an essential part of the unified approach to knowledge and life. While we must not expect the school to take the place of the community, it must nevertheless contain, in symbolic form, all that constitutes a community; so that the passage from reflection to action, from experiment to action, may be clear and direct. So, too, the dynamic equilibrium we seek to establish within the personality can be maintained only through widening the processes of organic planning and development in every part of the body politic. It is only by establishing an outer order that an inner order can be fully confirmed and adequately perpetuated.

Above all, we must avoid the temptation, which would be fatal to our efforts, to confine the task of synthesis to the field of rational knowledge alone. Our feelings, our passions, our evaluations, our fantasies, our ideals are no less concerned in the effort for unity than our scientific and practical procedures. For an objective order that attempts to exclude subjective elements as unreal or irrelevant inevitably ends, as ours has in fact done, by leaving the field open to an addled subjectivity; and under the rule of tolerance it permits conflicts and irrationalities to multiply to a point that disintegrates the personality and puts the community itself beyond the possibility of rational treatment. We must meet this disorder at the beginning. In an age that calls for integration we can no longer admit the widening of the breach between the objective and the subjective aspects of the personality; nor can we permit the present raw contrast between our public and our private worlds. That way lies stultification and paralysis. Not merely do the subjective elements of the personality belong to the public world, in the form of arts and symbols that are shared by all the members of the community. But it is equally important, of course, that rational knowledge should penetrate every nook and cranny of the private world, disciplining uncontrolled fantasy, disinfecting superstition, and destroying infantile survivals. Intercourse, co-operation, and, when necessary, rational conflict must take place between these now separated realms of the personality; it is better that differences should be openly expressed, than that indifference should permit them to harden into permanent obstacles to co-operation.

Fortunately, the search for an interrelated system of knowledge, for a balance of activities, for a unification of knowing, feeling, and acting, for an integrated community, is now going on in many different departments. That search is visible in the arts, no less than in the more ecological sciences; it has been

partly embodied, for instance, in the work of engineers, architects, and community planners, like those who are still planning the many-sided development of the Tennessee Valley. The very ideas of social planning, industrial planning, community planning, and regional planning presuppose not only an orderly body of knowledge and a common method of communication and co-operation; they rest on an acknowledgment of common values and purposes. If the work still has social limitations, it is because the values are only partly formulated and because the process of unification is still incomplete. But in the concrete expressions of architecture and land-sculpture, there is already visible in the Tennessee Valley, in complete esthetic form, a sample of an environment completely ordered to embody and sustain every aspect of the common life. This is a true parallel to the Greek Cities of the fifth century; and in such an environment we can reasonably hope that Nature and the City will both complete the formal education of man. One must put such premonitory achievements, which are equally notable in their esthetic and their practical aspects, alongside the similar efforts in the world of thought. Here it is enough to mention the philosophies of Patrick Geddes, Victor Branford, Lloyd Morgan, A. N. Whitehead, and Karl Mannheim, or, in another department, the admirable essay toward unity in the field of personology presided over by Dr. Henry A. Murray. These are but samples. Without this growing evidence of both the need and the response, however, the present paper would have only a remote speculative value.

Let me sum up. Our civilization is now passing from an era of expansion to an era that must achieve stabilization, cultivation, and balance, as the very price of continued survival. In our attempt to control the disintegrating forces that are at work in our society, we must resume the search for unity; and to this end, we must begin with the personality and the community

in all their richness, variety, complication, and historic depth, as both the means and the end of our effort. As the process of unification widens in the mind, as it multiplies the interconnections and the social co-operations between fragments of the personality now distant or insulated, we may expect to see a similar unification, a similar dynamic balance of forces and activities, a similar displacement of the one-sided power-impulse by an integrated life-impulse take place in the world at large. Such is the problem that confronts the organization of the American university in the opening future; and along some such lines as those indicated, I humbly believe, must be laid the foundations for the new City of Man.

The Role of Science in a Liberal Education

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LIBERAL EDUCATION is the process by which we attempt to transmit to the next generation the heritage of culture which our own generation possesses. The process is immensely important. We are born without our consent into a world we do not understand. Driven by an instinct of survival, a spirit of adventure, or faith in a higher power, we make the best of the situation. And we produce others who, on the same terms, will take our places when we are dead. Our only assets, both for ourselves and our children, are the faculties with which we are born and the accumulated experience of past generations. If we hope for success, we must develop the one and learn the other. These processes, I believe, represent what we mean by education.

It begins with disciplinary training, proceeds with the acquisition of current knowledge, and culminates with critical reviews of the accumulated experience of the race. The last stage, in particular, is identified with the liberal education.

Professional and vocational training is directed primarily toward making a living; toward learning the laws of the world, the properties of the things we must work with, and the technique for the actual manipulations. The liberal education is directed toward the good life and the full life, regardless of

how the living is made. It deals with general knowledge and experience against the background of history.

The heritage of culture can be analyzed into two ingredients—knowledge and wisdom or, in other words, science and values. We may know how an end may be obtained but we must judge whether the end is desirable. We learn the laws of nature, and we use them for good or for evil as we choose.

A clear conception of the roles of these two faculties is a necessary part of a liberal education. They are quite distinct, but they are so tangled in most human activities that it is seldom possible to separate them neatly. Perhaps the nearest approach to isolation is furnished, on the one hand, by a pure science such as astronomy and, on the other hand, by aesthetics. Since the present contribution is an attempt to examine the role of science, I will discuss, first, the pure discipline, then the applications, and, finally, the integration with values which forms the general culture.

Let me begin with an attempt to emphasize the distinction between science and values. The realm of science is the public domain of positive knowledge. The world of values is the private domain of personal convictions. The two realms together form the universe; they do not overlap.

Knowledge is public property. It can be transmitted directly, it can be pooled, and, consequently, it accumulates from generation to generation. Wisdom, on the other hand, is strictly private. It is not readily communicated, hence it cannot be pooled, and it does not accumulate through the ages. Each man acquires his own wisdom from his own experience. About all that can be done in the way of instruction is to expose others to vicarious experience in the hope of favorable reactions.

The essential characteristic of science is a very simple idea—the attempt to ascertain objective truth without regard to personal desires. Men of science, as all other men, spend most

of their lives in the great world of values. They play their roles as citizens and as human beings. They seek happiness in some of its many aspects; they may engage in politics or write fiction or paint or teach, and they play their roles sometimes as artists, sometimes as amateurs.

But occasionally they slip out of the circle into another world that knows nothing of values. There they attempt to explore the universe as it is; not as it should be, but as it is. They may not always achieve complete detachment, yet that is their conscious aim. Driven by sheer curiosity, they seek to understand the world; not to reform the world, merely to understand the world.

The urge to pure research is not always appreciated by laymen. They frequently describe the discipline in terms of inventions. They speak of "controlling the environment," of "harnessing the forces of nature for the benefit of mankind." Such descriptions are not correct. The research man himself knows that he is driven by a devil of curiosity and that he seeks merely to understand the world. As a scientist, he is aware of no difference in the dignity of pure research and the dignity of its applications. Yet if you press him hard for an opinion you are likely to arouse a quite unscientific gleam in his eyes and to hear him lapse into the language of values. Francis Bacon asserted that the contemplation of things as they are is, in itself, a nobler thing than a whole harvest of inventions. Change the adjective "*nobler*" to *more profoundly satisfying*, or even to *more amusing*, and you have the attitude of the pure research man. The curious fact that inventions are ultimately derived from such contemplation, and from no other sources, is not of immediate interest to the scientist. He seeks merely to understand the world.

The attempts began long ago. There was much fumbling, many false leads, and occasional breath-taking achievements.

Eventually, it was realized that one aspect of the universe could be explored, and that success was measured in terms of disinterested curiosity. Methods were developed under the leadership of Galileo and Newton, and modern science was launched on its extraordinary career.

A unique feature of this science is the fact that it is progressive. The body of positive knowledge is transmitted from generation to generation, and each contributes to the growing structure. Newton said, "If I have seen farther, it is by standing on the shoulders of giants."¹ Today, even the least of the men of science commands a wider prospect. The very giants are dwarfed by the great edifice in which their achievements are incorporated. It will continue to grow, and the future looms big with promise.

The world of values is quite different. When we look back over the history of art, for instance, we see dim undulating plains with great peaks scattered more or less at random. There is no clear evidence of trends. Sarton has described the distinction in these words:

The saints of today are not necessarily more saintly than those of a thousand years ago; our artists are not necessarily greater than those of early Greece; they are likely to be inferior; and, of course, our men of science are not necessarily more intelligent than those of old; yet one thing is certain, their knowledge is at once more extensive and more accurate. The acquisition and systemization of positive knowledge is the *only* human activity that is truly cumulative and progressive.²

The success of science is readily explained. Modern science was born when certain methods were consciously formulated for operations on a particular kind of subject matter. These methods are efficient and powerful within the strictly limited

¹ Letter from Newton to Robert Hooke, February 5, 1675/6, in *Isaac Newton*, by L. T. More, 1934, pp. 176-77.

² George Sarton, *Introduction to the History of Science*, 1927, I, 3.

field for which they were devised. Beyond that field, they are not valid. Thus the realm of science is determined by the subject matter.

Science deals only with those judgments on which it is possible to obtain universal agreement. These judgments do not concern individual facts or events but the invariable associations of events or properties which are known as the laws of science. Agreement is obtained by observation and experiment—impersonal courts of appeal to which men of all races and all religions must submit if they wish to survive. We were not with Newton when a particular apple fell, but we all agree that apples do fall and we behave accordingly.

I will not linger over this description, although it evidently invites discussion. For instance, it is sometimes urged that the necessity for universal agreement should be qualified by the phrase "among those competent to judge" or by some similar restriction. Such a requirement introduces more trouble than it removes, for it raises the old question of *Quis custodet custodes*. The actual operation of the simple formula is satisfactory. If a crank refuses to give verbal agreement, we watch his actions. Simon Newcomb, when one of the breed invaded his office with the announcement that the law of gravity was all wrong, invited the fellow to jump out of the window. And, in the end, if a man stubbornly refuses to agree with laws of nature, even by his actions, he is likely to die suddenly or to end in a padded cell.

The methods of science may be described as the discovery of laws, the explanation of laws by theories, and the testing of theories by new observations. Theories are inferred or invented or dreamed—it does not matter. They are mere working hypotheses—in other words, they are plausible interpretations of the data already available. Ingenious men can and do invent many theories to account for a given set of laws. But each of

the theories predicts new, hitherto unobserved laws; and, for this reason, they are vulnerable to new observations. The validity of theories is measured, not by their origin, but by the verification of predictions. The procedure is the very essence of the scientific method, and serves to control the powerful but dangerous instrument of induction. When theories cannot be tested, their appeal is largely aesthetic.

As laws accumulate, theories are constantly weeded out and the survivors, suitably pruned, tend to converge toward very general patterns. As theories become more general, they grow more abstract and more mathematical until, in the end, they become sheer logical concepts, conceived within the mind and projected against the universe in order to test their correspondence with nature itself. Mathematics has sometimes been called the queen, and sometimes the handmaiden, of science; but mathematics is not science. It deals with possible worlds, logically consistent systems. Their number is infinite, and science attempts to identify among them the particular world in which we live.

Research men sometimes describe their operations by the analogy of the jig-saw puzzle. The laws of nature, the permanent contributions of the observers, are the pieces of the puzzle. As they are fitted together, local patterns are suggested which are the theories. These bright ideas set the men hunting for new pieces to complete the patterns. Many of the suggestions are sterile, but occasionally one proves useful and new pieces fall readily into place. Sometimes a few isolated regions, developed in this manner, suggest broad underlying patterns; these are the general theories which bring large regions into proper relation. Research men have a notion that, when sufficient pieces have been assembled and co-ordinated, an ultimate pattern may emerge which will represent the structure and behavior of the physical universe.

The notion cannot be demonstrated, and there is considerable argument over the question as to whether it is a religious conviction or a working hypothesis. Some philosophers are inclined to call the notion a conviction and, for this reason, to charge the scientists with crass materialism—with an attempt to invade the mind and the soul with their measuring sticks. The scientists, for the most part, prefer the other view. They are exploiting a working hypothesis that has been highly successful up to the present and, consequently, must be pushed forward to the limit of its usefulness. If it should run into a barrier of self-contradiction, the boundary will be recognized and welcomed as new knowledge of fundamental significance.

To summarize briefly, the attitude of science is one of disinterested curiosity; the subject matter is the laws of nature, judgments on which universal agreement can be obtained by observations and experiment; the method consists in the actual discovery of laws and the explanations of laws by theories which are considered as mere working hypotheses until their validity is tested by the verification of predictions.

Under these conditions, science is necessarily restricted to one aspect of the universe, the objective world of phenomena. It deals with probable knowledge only; its methods are empirical, its philosophy pragmatic. The scientist explores the world of phenomena by successive approximations. He works in an atmosphere of probabilities; he knows that his data are never precise and that his theories must always be tested. It is quite natural that he tends to develop healthy skepticism, suspended judgment, and disciplined imagination.

The world of pure values has no concern whatsoever with probable knowledge. There, finality—eternal, ultimate truth—is earnestly sought. And sometimes, through the strangely compelling experience of mystical insight, a man knows, beyond the shadow of a doubt, that he has been in touch with a reality

that lies behind mere phenomena. He himself is completely convinced, but he cannot communicate the certainty. It is a private revelation. He may be right; but unless we share his ecstasy, we cannot know.

The attitude is dimly reflected on lower planes where men attempt to persuade their fellows of that which cannot be demonstrated. Subjective certainty is inversely proportional to objective certainty. The concept of probable error is peculiar to the realm of science. Russell emphasized this fact with two sentences: "It is characteristic of those matters in which something is known with exceptional accuracy that, in them, every observer knows that he is likely to be wrong, and knows about how wrong he is likely to be." Then, commenting on the fact that, where truth cannot be ascertained objectively men are loath to admit the possibility of error, he continues: "Who ever heard a theologian preface his creed or a politician conclude his speech, with an estimate of the probable error of his opinion?"³

Now a word concerning applied science. By way of introduction let me repeat that pure science is not at all concerned with the benefit of mankind. Research men explore the world of phenomena in much the same spirit as artists explore the world of values—for their own private satisfaction, and not for the good of society. Yet society supports them. Universities, foundations, occasionally industries and governments, support them—and for two reasons. The first reason is cultural. All men are curious; knowledge of the world stirs the imagination and drives away the nightmares of superstition.

The second reason is practical. Long experience has shown that among the reports of the pure scientists an occasional item turns up that can be put to practical use. The authors in general are not specifically interested in the applications of these items. Moreover, the possibilities are usually realized long after

³ Bertrand Russell, *The Scientific Outlook*, 1931, p. 64.

the discoveries are made, frequently after the authors are dead. Yet it is a fact, and society recognizes the fact, that inventions are by-products of pure science.

Faraday, curious about the nature of electricity and magnetism, studied the behavior of electric currents in magnetic fields. Years later, the principles he formulated were put to practical use and, within a century, there developed the vast electrical industry of today. Wherever we find a motor or a generator we may recognize a by-product of Faraday's disinterested explorations of the world.

The exploitation of scientific results is very evident in our generation. The tremendous advances in technology are almost too familiar. They tend to destroy the perspective. Technology strides across the modern stage like some gigantic, stream-lined god. Some, instinct with the spirit of craftsmanship, worship the machines for their very perfection. Others, fearing the reckless ignorance of mortals, nervously urge that the demon be exorcised. But the world at large accepts the machines for what they are—powerful instruments that may aid us to attain whatever goals we judge desirable.

Many of the great industries have established research laboratories of their own. But these, in general, are quite different from the dens of pure research. They are devoted not to the disinterested study of the world but to the rapid and efficient solution of specific problems, almost necessarily by the use of basic principles already known. They are commercial ventures in which research is regimented and freedom of inquiry is curtailed. Only rarely are directors of industry bold enough to risk their stockholders' good money to support a pure scientist on the loose. Most good businessmen prefer the short view (I suppose that is why they are good businessmen); and practical by-products of pure science are chancy gambles—on the short view.

I have used engineering as an example of applied science because, in that field, the distinction is especially clear-cut. Other fields would have served, but in some the line is more difficult to draw neatly. The medical sciences, for instance, represent a borderline case. Research work is directed toward an understanding of the living body, its normal behavior, and its pathology. Practically all of the results are directly related to the immediate well-being of men, and many of the programs are inspired by that motive. Nevertheless the distinction is there as in all fields—knowledge for the sake of knowledge, and the applications of knowledge for the use or the abuse of society.

I have insisted that the pure scientist, while immersed in his study, knows nothing of values. He explores the world as it is, not as it should be. The heights of disinterested curiosity are reached during brief intervals of concentrated activity. Most of his life is passed in the great world of values. There he is a citizen among other citizens, and he shares the common responsibility.

The knowledge which science brings forth he considers good in the same sense that beauty is good. The applications, he realizes, are made for ends that are generally good but are sometimes evil. Occasionally a layman is so appalled by the evil applications that he wants to stop all research, to throw out the baby with the bath. The answer, of course, is simple. Evil applications can always be stopped when citizens have the will and the energy to use force in the process.

There is an emergency of this sort at the present time. The scientists are already playing the role that all good citizens must play in a democracy. They are sacrificing their immediate freedom (of inquiry) for the purpose of insuring their future freedom. They are submitting to regimentation for the duration—organizing themselves into a gigantic national laboratory in applied science. They are being told what specific problems

must be solved in order to defend our democracy, to destroy the evil power which threatens it; and they are busy with the solutions. And they are very earnest about the business. Liberty and intellectual freedom are essential conditions for pure research. Because this symposium is concerned with the university and the future of America, I will enlarge upon the point. The first step is to secure a future in which a university can operate.

Three hundred and eight years ago Galileo was arrested by the Inquisition. Under threat of torture he was ordered to retract certain published, scientific conclusions—in particular, a statement that the earth is a planet which circles around the sun. Galileo, old and ill, complied; but the attempt at appeasement was not wholly successful. He was kept under technical arrest—confined to quarters and under observation—for the balance of his life.

The episode is one of the minor scandals in the history of civilization. This next year, the three-hundredth anniversary of Galileo's death, offers a suitable opportunity for the Catholic Church to make some gracious gesture of restitution. Many of us hope the opportunity will be realized.

As a young student, I read the persecution of Galileo as a miserable episode of a past age that could not possibly happen again. But today we are not so sure. After these many generations of intellectual freedom, the old spirit of intolerance is again spreading over the world, this time in the guise of political, rather than theological, orthodoxy. Russia, we are ready to disregard, and Italy does not worry us unduly. We are inclined to regard their present maladies as temporary aberrations which time may cure. And, at any rate, both communists and fascists seem to be ineffectual.

But Germany is a different story. Here is a great nation, with an impressive history of intellectual achievement—and

deadly efficient. The rapid development of intolerance in Germany is a grim story; for the ideology is spreading with Germany's conquests and is a menace to the whole world.

I will not attempt to tell the story, but will merely mention three brief incidents which bear on my particular subject of scientific research. In 1869 Helmholtz made his boast at Innsbruck. Germany, he claimed, held first place in the development of natural science because the German savants, unlike their French and English colleagues, could proclaim the truth as they found it, without regard to the opinion of the world, or to social and religious prejudice.⁴ Helmholtz, of course, was waving the flag, in a way we Americans sometimes indulge our enthusiasms. But, at any rate, he was emphasizing the intellectual freedom in Germany, and the prestige the nation gave to the disinterested search for truth.

Compare this statement with another, made in 1936 at the Jubilee celebration of the University of Heidelberg, by the Reichminister of Education, in the major address of the occasion. He said: "National Socialism has provided science with new principles from which she can derive the strength of self-confidence The old idea of science based on the belief in the supremacy of the intellect, is finished."⁵

In 1939, the final step was taken. We read that "German censorship will in the future *see* all scientific works written for Doctor's theses *before* they are submitted for scientific examinations."⁶ This ordinance, it was specifically stated, was intended to guard against the introduction of theses offending against Nazi doctrines in politics, law, literature, and population

⁴ *Les Mondes*, XXI, 552. See also *Nature*, CXXXIX (1937), 666.

⁵ From the speech by Herr Rust, as translated in *Universities Review*, November 1936.

⁶ From a report by the Berlin correspondent of a Copenhagen newspaper, quoted in *The Times* (London), November 13, 1939.

principles. Germany is no longer concerned with the search for truth in investigations of the facts of nature and history but only with the fanatical application of a selective theory dictated by political prejudice.

As the test of observation and experiment was once forcibly subjected to the authority of the Church, so today, in Nazi Germany, it is subjected to the authority of the political state. Pure science has been abolished in the German universities, and its spirit has abdicated from the Reich. The great mass of the German citizens have been reduced to serfdom. It is therefore appropriate that their minds be enslaved along with their bodies, for slavery mercifully provides its own spiritual anesthesia.

So the Galileo episode is not remote. Such things are happening today over most of Europe. And they can happen here, they will happen here, unless we do our plain duty. Let us never forget that our liberties and our freedom are a heritage from brave men, who, the world over, since time began, have fought to achieve and to maintain them.

The liberal education is not directed toward the special discipline of pure research nor, indeed, toward specialization in any field. It strives for general knowledge, for the integration of partial glimpses into a broad map of the world. And, at the same time, it considers the modes in which men proceed from the known to the unknown. Its object is to make capable and cultivated human beings. The end is important both to the individual and to society. The individual acquires the spiritual independence that comes with a broad outlook, an intellectual curiosity, and a well-stocked mind. His appreciation of the present is enhanced by a sense of the past. In solitude he is not lonely, in company he is not strange.

Society benefits in proportion to the number of capable, cultivated minds among its members. Democracy, in particular, is dependent upon the ability of citizens to distinguish between

words and the facts they represent, and to judge between conflicting opinions offered as vital truths. Hobbes said: "Words are wise men's counters, they do but reckon with them: but they are the money of fools,"⁷ and Mill remarks that "the ability to judge correctly of evidence is the principal and most characteristic difference between one human intellect and another."

Mill emphasized the value of the study of science in this respect. It teaches us, he said, "to generalize our conception of the resources which the human mind possesses for the exploration of nature; to understand how man discovers the real facts of nature, and by what tests he can judge whether he has really found them." "Our whole working power," he continued, "depends upon knowing the laws of the world—the properties of the things we have to work with, among, upon Without an elementary knowledge of scientific truths, the public never knows what is certain and what is not; who are entitled to speak with authority, and who are not They have no faith in the testimony of science, or they are the ready dupes of charlatans and impostors they alternate between ignorant distrust and blind, often misplaced, confidence."⁸

Mill's inaugural address, delivered at St. Andrews in 1867, is a classic in the literature of education. It overshadows the contributions of Matthew Arnold and other popular writers of the time largely because Mill had a truly liberal education and recognized the nature and the significance of science. Arnold, on the other hand, was a humanist, with the old humanist's distrust of the newer discipline.

Pure science developed in respectable isolation, but toward the end of the eighteenth century its spreading applications began to stir up animosities. It was in those days that the popular

⁷ Thomas Hobbes, *The Leviathan*, Pt. I, chapter IV (p. 18 of edition by A. R. Waller, Cambridge, England, 1904).

⁸ John Stuart Mill, "Inaugural Address at St. Andrews," 1867.

distinction arose between the *savant* and the *scientist*. The one was a disinterested student of nature, a spectator, as it were. The other was a meddler, an atheist, most likely, at any rate one who was dissatisfied with the existing order and was forever trying to change the world. After a long and rather vociferous squabble, the scientist has established his position at least in the eyes of the public. In Arnold's day a project was called "scientific" in order to condemn it as visionary and impractical. In our day the term is often used in the market places as a crushing answer to every objection.

The university curriculum has long formed a conservative program. The trivium and the quadrivium of medieval days remained relatively intact until the great expansion of classical study during the Renaissance. Modern science was developed outside the walls. Except in the field of medicine and astronomy, few chairs of science were established before the seventeenth century.

For a time, it seemed possible that science—natural philosophy—might be thoroughly integrated with other disciplines to form a truly liberal education. But the opportunity was not fully realized. Science and the humanities proceeded along quite separate paths.

Universities reacted slowly to the extramural commotions until about the closing decades of the nineteenth century. Thereafter the study of science spread rapidly, with growing emphasis on the specialized aspects of the discipline. The field is so vast and the preparatory training is so thin that the university courses are devoted largely to the acquisition of detailed knowledge rather than to the critical review of general knowledge. The program sweeps forward impetuously with little regard for the humanities. The future is bright with promise, there is little time, and much to do.

And the professors of humanity, with certain notable ex-

ceptions, have not greatly encouraged close co-operation. They remember an old slogan—the proper study of mankind is man. The liberal education of the last century, as Barry described it, “was not the study of the great world of nature but the study of man alone; and the study of man, not as a product and plaything of nature, but as a free immortal soul; and no longer a struggling, humble soul, working its blind way toward the light, but as an ardent soul, whose thought was more interesting than his work, and whose love and play and dreams and songs, were more important than his thoughts.”⁹ The emphasis was placed on the past. The student was made familiar with the finest creative efforts of the race. Habits of thought were developed in keeping with a great tradition.

This spirit still pervades the humanities. Its ideals are high and must always be cherished. But, like science, the humanities alone are not sufficient. Sarton has said that he does not know which is the poorer, the old humanist who does not recognize the cultural values of science, or the young scientist who lacks appreciation of beauty, of urbanity, and of reverence.¹⁰

Today we strive for the larger view. We believe that the proper study of mankind is the universe, of which man is a part. We must explore both the realm of science and the world of values. For we believe that wisdom without knowledge is futile, and we know that knowledge without wisdom is dangerous.

The two aspects of the universe are distinct and cannot be fused into any more general conception. The distinction must be clearly understood and preserved in any significant integration. The humanist must recognize the complete authority of science within its proper field; the scientist must recognize the

⁹ Frederick Barry, *The Scientific Habit of Thought* (1927), p. 285.

¹⁰ George Sarton, *History of Science and the New Humanism*, 1931, p. 72.

strict limitations of that field. Under these conditions the two can work together toward the ideal of a truly liberal education.

A common meeting ground is furnished by the study of history—in particular, by the history of culture, of ideas, and of science. The historian with a general knowledge of science, the scientist with an appreciation of scholarship, can encourage and contribute to this end.

The general synthesis is largely a problem for the future; but the movement is under way and has made some progress during the past generation. A few men have blazed trails that others are following. As chief among them, I would name George Sarton; but he is not alone. The project should be encouraged by all universities who have not forgotten the old phrase, *studium generale*.

Let me cite one example. Something tremendous and mysterious happened in Greece of the fifth century B.C., in China of the seventh and eighth centuries A.D., in Europe of the sixteenth and seventeenth centuries. Great, hidden potential capacities of men were suddenly released to develop in all directions. Wars and dynastic changes are insignificant when compared with the spiritual consequences of these brief episodes. We still feel the impetus of the last Renaissance. Modern science, for instance, was formulated by a few men of that period. We do not yet understand these rare surges. If we knew why and how they occurred we might be better prepared to meet our present desperate situation.

The record of intellectual and cultural achievements is perhaps the capstone of a liberal education. A critical review of the record would be of value to the student as an individual, a member of society, and a citizen of the world. The suggestion of new courses may not be welcomed by universities that are already overcrowded and understaffed, yet there is much to be said for the venture. The spirit of professionalism and special-

ization has spread widely through the halls, especially in the field of science and the pseudosciences. It is necessary to make a living in this world; but, in addition, it is immensely important to live well. Let us by all means liberalize the professions, but let us avoid professionalizing the liberal education.

In conclusion, let me emphasize one point. A university education is not a necessity for any man. It should be maintained at a high standard of quality, and it should be reserved for the selected few who have both the urge and the preparation to take full advantage of exceptional opportunities. The university degree should represent a quality of distinction that marks the holder among his fellow citizens. By his unconscious example, by his manner of living, his sense of responsibility, his record of performance, he should deserve and win the confidence of his neighbors. If he is true to his training, he will be utterly free from that smugness and presumption which democracies have detected and resented in the superficially educated. Under these conditions the university men may set the tone of society, to the lasting good of the nation.

Certain institutions, Stanford among them, hold such ideals. But many colleges and universities throughout the country operate on a lower level. In competition for students they sacrifice quality for quantity, and they encourage so many extraneous activities that, with some justice, the analogy has been drawn with the drugstore—notions in the front windows, pharmacy in a rear closet. These are the schools which spoon-feed the majority of their students, which entertain them with interpretations of the classics rather than the classics themselves, and which have suggested to the cartoonist his picture of parents distressed because the diploma carried no further instructions.

There are grim days ahead; I doubt if all the existing institutions can survive. Perhaps we can make a virtue of a necessity, and indulge in a little housecleaning. Half of the colleges

and universities in the country could probably be sacrificed without serious detriment to the nation. But, in the process of elimination, we must be sure to preserve the best. It is the leaders, and not the rank and file, who determine progress. If anyone complains that this attitude is undemocratic, let him read Thomas Jefferson on the school system.

I will not discuss the most imperative requirement for university education, namely, the introduction of real mental discipline into the secondary schools. If youths learned how to study, they themselves would profit, and the problems of the university would be enormously simplified. Nor will I discuss the desirability of removing vocational training from universities, turning it over, perhaps, to an enlightened public school system.

My concern, at the moment, is with the balanced curriculum of a liberal education, in which science and the humanities enter on equal terms and are integrated through the medium of history. Along these lines, I would urge, the university can contribute in the future even more than it has contributed in the past toward transmitting to our children the heritage of culture which we received from our fathers and are revising by our own experience.

Problems Confronting Medical Investigators

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IN RELATION to their special concerns men of science face problems of two sorts. First, there are the enticing direct questions, presented at the outer boundaries of existing knowledge, as to what may lie just beyond. Many investigators in astronomy and biology, for example, have had their imagination stirred by such questions. To satisfy their curiosity they have striven persistently for more facts. And the facts have led to understanding of the vastness of interstellar space and the immense duration of evolutionary processes. But these facts have had an impact on society which has led to profound changes in the outlook and judgment of all thoughtful people. The revolutionary social effects of advancing science raise the secondary, more indirect questions regarding the significance of scientific progress for humanity. Such questions, also, challenge scientific workers, as they challenge other intelligent members of the body politic.

In the present essay our attention will be directed in the main to the primary professional questions awaiting medical investigation. Before they are considered, however, it may be well to note that the social effects of progress in medical knowledge appear to be of such favorable nature as to permit it to escape the harsh strictures sometimes drawn against science in

general. If this is true the promotion of medicine by research should be commonly recognized as set apart in a special class, where frank encouragement should prevail rather than any aversion or hostility. Let us see what could possibly justify the unqualified support of medical investigators.

The question whether the advancement of science has not done more harm than good has been raised increasingly of late by apprehensive observers. New powers have wrought such havoc and destruction that men begin to fear the acquisition of new knowledge. Unable to check its perversion to evil purposes they propose to stop, at least for a while, further scientific progress. No one has expressed more vividly this terror of fresh discoveries in the world of nature or laid upon scientific endeavor a more sweeping curse than George Gissing. "I hate and fear 'science'," he wrote, "because of my conviction that for long to come if not for ever, it will be the remorseless enemy of mankind. I see it destroying all simplicity and gentleness of life, all the beauty of the world; I see it restoring barbarism under a mask of civilization; I see it darkening men's minds and hardening their hearts; I see it bringing a time of vast conflicts, which will pale into insignificance 'the thousand wars of old,' and, as likely as not, will overwhelm all the laborious advances of mankind in blood-drenched chaos."

This terrific indictment, one may justly assert, does not apply to the science of medicine. By the careful studies of medical investigators devastating pestilences, which formerly spread terror through great populations, have been wholly abolished. No longer do we witness such scenes as Defoe reported in his description of the disastrous plague in London in 1665—"people in the rage of the distemper or in the torment of their swellings, which was indeed intolerable, running out of their own government, raving and distracted and oftentimes laying violent hands upon themselves, throwing themselves out of windows, shoot-

ing themselves, mothers murdering their own children in their lunacy." The extinction of such horrors by scientific effort should certainly mollify, if not refute, the bitter charge that science is "the remorseless enemy of mankind."

And many another beneficent triumph of medical research can be cited. Ravaging and distressing diseases, such as typhoid fever and diphtheria, have been all but wiped out. Increasing control of malaria, yellow fever, and hookworm has not only lessened greatly the misery of myriads of human victims but has rendered safely habitable by man large areas of the earth where once he dwelt only at his deadly peril. Tuberculosis, long "master of the kings of death," has been dethroned; and the apathy of ignorance and despair toward it, formerly felt by both the victim of the disease and the helpless doctor who attended him, has changed to hope and cheer. Lying-in hospitals, from which at times as many as a third or a half of the mothers were carried away dead of childbed fever, are now havens of safety and helpfulness. The conquest of surgical sepsis has enabled the surgeon to apply his skill to any part, to belly, chest or brain, in order to repair damaged structure, remove dangerous new growths or deal effectively with invasion by harmful germs. Precise studies of the ways in which the organs of the body collaborate to perform their functions have revealed the marvelous nicety of the adjustments of means to ends, and have established reliable standards for quick recognition of disorder. Aided by delicately discriminative devices—the X-rays, electrical registration of the heartbeat, tests of functional capacity of various organ systems—the physician now enters the sickroom with deeper insight and a more reasonable confidence of being able to learn the nature of the complaint than his predecessors could possibly have possessed.

These successes in solving the complicated problems presented by human beings in their relations to one another and

to lower animals, to their shifting environment and their microscopic foes, have given medical investigators well-justified confidence in the efficacy of scientific methods. The repeated sequence of well-based ideas, and cautious experimental tests, and limited inferences, that has characterized the victorious advance of medical science, will, they firmly believe, continue to bring forth desired results—results ultimately useful in the relief of man's estate.

There is need for this confidence, because many serious problems remain to be solved. Some of them, cancer, for example, have long been impressive and insistent. Others have become more prominent as a consequence of medical research itself. Due to various conditions—and especially to improved medical care—the population of the world has doubled during the past hundred years. Vast numbers of people have gathered in immense cities, where they live their stressful days in a manner sharply different from that of ancestral custom. The great cities permit concentrations of workers in huge industrial plants—*specialized* workers dependent for their daily bread on a precarious daily wage. The age structure of our population has been much altered. Formerly, the high birth rate and a continuous arrival of young immigrants made us a relatively youthful people. Since 1900, however, the birth rate in the United States has dropped more than one-third, and immigration has been drastically reduced. Accompanying these changes there has been a falling death rate extending to the sixth decade of life and therefore an increasing number of the elderly in the population. Specialization of labor, insecurity of remunerative positions, and an altered distribution of age groups all collaborate to present new questions for medicine to answer.

An ideal service which a university may perform for society is that of welcoming new ideas, examining them criti-

cally, evaluating them so far as possible without prejudice, and stating clearly their implications and the probable consequences of putting them to practical use. The medical department of a university should participate in these obligations. Its leaders should note the trends of social change as they may affect the demands on the medical profession, and should prepare to meet those demands with intelligence and skill. Let us consider some of the more important problems which are presenting themselves, in order that we may learn what should be done.

First, we may examine the shift of age groups, already mentioned. In Sweden, where careful records have long been kept, the average length of life, late in the eighteenth century, was 34.5 years, a figure only slightly higher than that estimated for ancient Roman times; by 1840 it had increased by 7 years; and now, after decades of applied measures of public health, the increase is 28 years—from 34 to 62. Similar changes have occurred in our country. The recent speed of development of this highly significant phenomenon is illustrated in the reports of a large American life insurance company. During the quarter-century between 1912 and 1937 the life expectancy of its *industrial* policyholders advanced from 45 to 60 years—an advance of 33 per cent—and the prospects of the general population are even better. This means that we must prepare for a future in which a larger proportion of our people than at any time in past history will reach at least threescore years in their life span. In England, between 1901 and 1937, the percentage of individuals over 60 rose from 7 and a fraction to 13, an increase of nearly 80 per cent. It is conservatively estimated that if present trends in the rates of birth and mortality continue in our country, and they bid fair to do so, by 1980 more than 14 per cent of our population will be 65 years of age or older—approximately 22 millions instead of the 3 millions (or 4 per cent) of forty years ago.

Besides the social, economic, and industrial problems which the current increase in the number of the aged imposes, there are medical problems which, though long recognized, have been long neglected. As one grows older the fires of life burn less vigorously and the adjustments of bodily organs to emergencies tend to be impaired—the breath is shorter, the heart beats less effectively, the blood pressure gradually rises as the years pass and becomes ill adapted to critical requirements. Are these features essential attributes of the elderly or are they the consequences of comfortable and habitual indolence? We know that in middle age some of these effects may result from inactivity alone and that they can be reversed by training. In the later decades, also, could they be altered by effort? Should attempts be made to alter them? What would be the effects if they were altered? These questions offer possibilities of useful research.

Then there are the characteristically different diseases in the older members of society as compared with the younger members. Chronic disorders, starting insidiously and creeping onward until they overwhelm the working ability of the victim, are not infrequent. Thus, impaired functions of the heart and kidneys, the limitations set by diabetes, the ravages of cancer, the stiffening of the arterial vessels in the brain and elsewhere accompanied by reduction of the blood supply to the tissues and by dangers of shock and paralysis—these and other persistent afflictions are likely to replace the infectious diseases encountered in earlier periods, as hazards to existence.

The mortal attacks on indispensable structures of the body—on heart, brain, and kidneys—are not the only calamities of old age. These attacks do, indeed, kill. There are others, less dangerous, which sorely torment. "Rheumatism" itself and its commonly assumed guises (neuritis and lumbago, for examples), chronic inflammation of the bronchial tubes, asthma,

persistent itching, which are not unusual distresses in the elderly, can render the period of senescence wearisome and miserable. Confronting such possibilities the middle-aged are naturally apprehensive as the years draw nigh when, it is said, one has no pleasure in them.

Here is a complex group of very difficult problems calling for solution. Almost none of the most prominent disorders of senescence is understood. The prevailing ignorance, we may assume, is largely due to lack of systematic study. We may reasonably expect that geriatric research, the application of scientific methods to the disorders of senescence, will reveal their nature, the conditions which induce them, and the possibilities of diminishing their incidence and their injurious effects. Death, of course, must come when one or another vital organ fails its duties, but while life lasts no effort should be spared to make it a good life. Medical investigators have much to learn about how to maintain health and preserve a satisfying ability to be useful in the growing numbers of their fellows who reach the seventh decade and beyond.

In order to catch the early signs of defect, reliable measures of physiological fitness are needed. Critical tests must be devised which will reveal the ability of the organism to withstand stresses at different periods in the span of years. Criteria for judging the degree of perfection of the protective and corrective devices of our bodily economy must be established. Early infections, early injuries (both psychic and physical), early malnutrition or hygienic neglect in relation to the decrepitude of the last decades must be studied as carefully and thoroughly as possible. This will be a protracted, exacting, and expensive program. University medical schools should take up the challenge and set forth in an attempt to give to the people of our country, since they are to have a longer life, the assurance that they shall have it more abundantly.

Severe demands on the nervous system, which have become progressively more severe in the recent past, have had results calling for medical attention. The conditions which have arisen may be in part the accompaniment of a remarkable shift in the occupations of our citizens. From a population 60 per cent rural in 1900 we have become a population 60 per cent urban. In that overturn the cities have gained from the farms more than 30 millions of inhabitants. The admirable liberty, independence, and opportunity for self-direction which typify the pursuit of agriculture have to a large degree been exchanged for a routine of fixed hours, monotonous tasks, and a sedentary existence which breaks in sharply on the ancient racial habit of using the big muscles of the body for earning one's daily bread. Furthermore, as hired hands—bookkeepers, clerks, and accountants, or as operatives in foundries and factories—city dwellers become entangled in the widespread web of dependency. Labor strikes, business failures, and revolutionary inventions involve familial tragedies of lost jobs, wrecked plans, and broken homes. The intense drive and pressure of the new life, its worries and its dreads, place a burden upon men and women which often is too great to be borne. The strain is mirrored in the rise of the suicide rate of the United States during the years of excitement and depression near the beginning of the last decade. It went steadily upward until, in 1932, it was over 50 per cent higher than during the five years after the first World War. That rise meant an increase of more than 6,000 suicides in 1932 alone.

While the stresses which affect the nervous system have been on the increase since the turn of the century, the seriousness of infections has been undergoing a remarkable decline. To this altered situation medical science has been slow in adjusting itself. The technique required for understanding nervous influences is novel and not well developed. A disorder of the brain

may fail to reveal itself at the autopsy table or under the microscope. And yet emotional upsets, which leave in the nervous pathways no visible trace, have concrete and obvious effects, and may be the occasion for profound misery and suffering. Obsessive fears disturb or interrupt digestion, alarmingly accelerate the heart, send the blood pressure oscillating in hot flushes, or impress a deep and stubborn sense of agitation. The poor patient, not finding sympathy and interest elsewhere, may take his troubles to faith healers or to other cultists who are attentive and who confidently promise aid. It is stupid to belittle or neglect such complaints. The powerful influence which emotional states can exert on bodily functions needs no argument. The ways in which the processes of the brain produce disturbances, however, are little comprehended; and the devices which might be employed for prevention or cure have not received the scientific attention which their importance demands. The problems which are posed are especially difficult because, in the brain more than in any other organ, man differs from the lower animals. For that reason studies on the lower forms are suggestive rather than conclusive. It will probably be necessary, therefore, that medical investigators of the neuroses, while maintaining a firm basis in physiology, shall rely on the clinic in order to find subjects for their research.

Closely associated with the mysteries of nervous instability is the most complex of all medical problems, that of mental derangement. The custodial care of the insane has immeasurably improved since St. Mary's of Bethlehem in London gave the English language the word "bedlam," and decades have passed since the wretched victims of a diseased mind were chained in outhouses and treated like wild animals. Nevertheless, in the great asylums custodial care continues to be almost the only type of treatment. And meanwhile the problem grows constantly greater and more startling. The numbers of the

mentally afflicted who have been safeguarded by the state of New York rose from 390 per 100,000 in 1920 to 525 in 1938, an increase of nearly 35 per cent in eighteen years. And the appalling fact is now disclosed that as the age range lengthens, there are more and more victims of mental disease for whom protection is necessary. For example, between 1912 and 1936 the population over 40 years of age in the United States rose about 6 per cent. During that period the first admissions of patients over 40 years of age into the mental hospitals increased from about 8 to 49 per 100,000, an increase of more than 500 per cent. Half of the hospital accommodations of the country are devoted to the insane; and it is estimated that one-fifth of all hospital beds are occupied by sufferers from a single mental disorder, schizophrenia. Hundreds of millions of dollars are spent every year—New York alone voted more than thirty-one millions in 1938—mainly to provide a place of refuge for the mentally diseased. Wards are extended and new buildings are erected in order to accommodate the growing numbers. Meanwhile, only relatively trifling sums are being devoted by the states to learn preventive measures by which the incidence of mental derangements may be lessened or to discover methods which could be used to treat these derangements effectively. The outlook is not hopeless. Within the past score of years an apparently intractable disorder of the brain, general paresis, often associated with most fantastic delusions, has yielded to artificial fever and can thus be cured. Furthermore, new modes of bringing back to lives of sanity and realism persons plunged in apathetic indolence or futile daydreams are now being tried, with a promising proportion of remarkable successes. The stupendous personal, familial, social, and economic importance of the problems of psychiatry calls urgently for the labors of many well-disciplined medical investigators devoted to research in this field.

The gradual onset of disabilities, bodily and mental, in the later years of life demands long-range studies on the possible influence of inheritance, early injuries, severe infections in childhood and youth, frustrated plans, the demands of labor, and probably many other conditioning experiences. Because we each become more and more individualized as we grow older, the kind of study which is required must be correspondingly individual. Only after the collection of a vast amount of information will any reliable summary be possible.

It may be that the "general practitioner," if properly trained, would be in a more favorable position than any other type of physician to secure information useful in tracing the course of slowly developing organic disease. He would be especially well placed to obtain that information if there should be an awakening of both the public and the medical profession to the supreme value of positive, vigorous health. The advantages to be derived from securing health and physiological efficiency instead of being repaired after a breakdown needs to be emphasized. Are not hosts of our people unaware of their defects, as revealed, for example, in our young men when called to military duty? Do many of us realize that minor ills can spoil the keen edge of living? Do we strive to get into good physical condition and stay there? Do we give to our bodies, which are composed of irreplaceable parts, anything like the attention we give our machines with parts replaceable? If the human body is subjected to stress, as it is sure to be when adult responsibilities are assumed, it needs periodic examination to determine whether it is standing up well under the stress. Thus the early stage of a disorder—the stage when treatment is most effective—can be detected. If only through public education the physician might become the conservator of the family health, keeping the members well so far as possible and being instantly ready to care for them when they fall ill, an enormous benefit

would be gained in the well-being of our population. And there would be established a new position for the doctor. He would become a leader in bringing about better modes of living. He would be a teacher of his people in proper diet, in proper hygiene, and in ways of avoiding conditions which induce disease.

In order that the functions of the physician as a personal or family "health officer" may be reliably performed, standard tests must be devised which will reveal the ability of the body to withstand disturbing influences. Normally our organs maintain a remarkably steady state, a condition of homeostasis, in the circulating blood. No dangerous variations of temperature, blood sugar, or alkalinity are permitted. This stability of what has been called our "fluid matrix," in which our living parts reside, is essential for the performance of all our voluntary acts. We now know that as old age approaches, the power of maintaining that stability in the presence of deranging circumstances is gradually reduced.

As a means of obtaining further information regarding human faculties methods of assaying organic efficiency are needed. If medical investigators should invent methods for learning how human experiences affect the fundamental factors which determine homeostasis, a broad territory for medical exploration would be disclosed. The physician, for example, could learn how steady are the steady states and where the critical stress is found, not only in supposedly normal individuals, but also in individuals at various developmental epochs and during various disorders. In an illuminating series of tests the abilities of the same individual could be followed in childhood and adolescence, in adulthood and old age, as affected by the demands of school, or the exacting periods of puberty and the climacteric, by prolonged labor, fatigue, high altitude, different sorts of training, insomnia, worry, and dissipation. Information thus

obtained would furnish a measure of physiological age, a measure much more important for many judgments than chronological age. The information would also furnish, in time, a firmer basis for sound advice regarding the right conduct of one's life—the habits to be cultivated and the pitfalls to be avoided.

We now turn to another topic, the use of drugs. There was a period, not so long ago, when, with few exceptions, the possibility of affecting the course of disease by employing chemical agents was too remote to be entertained. While pathological anatomy dominated medical thought, examination of bodily tissues after death revealed alterations in them which were so extreme that any attempt at their restoration to a natural state by drug treatment was commonly regarded as futile. So great was the lack of trust in medicaments that now that period is looked back upon as an era of "therapeutic nihilism." Advances in medical knowledge have slowly reversed the attitude of despair and have disclosed opportunities of a bright future. Diseases have gradually come to be recognized at earlier stages, when the features which are prominent are altered physiological functions. Then, before the fixed and final structural accompaniments have become established, therapeutic measures can be effective. Furthermore, hope has been revived by illustrious discoveries of specific means of curing illnesses formerly regarded as extremely dangerous or quite incurable. Antitoxin, for example, has banished the terrors of diphtheria; extracts of glands of internal secretion have, with magic potency, rescued the cretinous child from his idiocy and brought both life and vigor to wasting diabetics; preparations of liver have pushed death away from the bedside of patients succumbing to pernicious anemia; nicotinic acid has marvelously restored both the bodies and the minds of victims of pellagra; and within the last few years the miraculous cures wrought by the sulphona-

mide compounds have opened a door to the future that is of limitless significance.

At a time when pharmacology or pharmacotherapy faces the brightest prospects it is found to be badly neglected. In about a third of the medical schools of the United States there is no independent department devoted to the experimental study of the action of drugs and to their use in treating disease. A discipline which should enjoy a central position among the dynamic medical sciences, sending its roots into organic chemistry, physiology, biochemistry, and exploratory pathology, and thrusting its outstretched branches into various hospital clinics, is often merely an incidental interest in a collateral department of the medical school.

As we have previously noted, there are many afflictions which scourge mankind concerning which almost nothing is known. Do not the triumphs already achieved give promise of further conquests? Will not trained intelligence applied to the problems of cure bring further relief to humanity in its suffering? Should not the possibilities of control of the processes of pathology be explored to the uttermost? Here, in the realm of therapy, is another gage thrown down before the investigators of medical mysteries.

A problem which confronts workers in the medical sciences and which fortunately does not disturb workers in other sciences, except psychology, is that of preserving freedom to carry on research. The amazing advances of modern physics and chemistry and their uses in arts and manufacture have developed from experimentation. Likewise the revolutionary progress in the control of disease that has been achieved during the past ninety years has resulted from practical applications of results obtained by experiments. In order to employ the experimental method, however, the physiologist, pharmacologist, or immunologist must put his questions to living organisms and

obtain from them his answers, for only they are capable of responding. Because medical investigators perform experiments on lower animals, however, they have been reproached and persecuted and had all manner of evil charged against them falsely. The hostile charges can be analyzed into two main groups—that animal experimentation is conducted with an intolerable infliction of pain, and that all the effort and expense are utterly useless.

It is not generally known that about a third of a century ago faculties of the medical schools of the United States established by formal vote their own humane code for the treatment of animals used in experiments and provided that this code should be posted in all laboratories where animal experimentation is extensively practiced. To anyone widely acquainted with medical investigators and the methods which they employ, these regulations, when they were adopted, merely defined the already humane conditions under which experimental medicine was being conducted and stated a program for the continuance of those conditions. To beginners in research and to interested people the regulations indicated the spirit of the investigators and the consideration given by them to the avoidance of unnecessary pain. So assured were the deans of medical schools and the directors of institutes of medical research that animals are treated in the laboratories in a manner above any reasonable reproach that twenty years ago the "open door" policy was adopted. In accord with that policy there was a publicly declared willingness to admit to the laboratories at any time representatives of humane societies in order that they might become acquainted with the actual conditions under which animal experimentation is being carried on. In some instances it was stipulated that the representatives must have previously seen an operation on a human being to enable them to appreciate the similar humaneness of the laboratory methods.

The charge that the results of experiments on lower animals are useless has been amply disproved. Articles by well-known physicians, surgeons, and public health officers—all recognized experts in their several fields—have been prepared and published in the most widely circulated medical journal of the country, showing definitely how animal experimentation has contributed in a direct and decisive and fundamental fashion to practical medicine and surgery.

In spite of overwhelming evidence that animal experimentation is carried on in a humane manner, in spite of practically unanimous expert testimony that animal experimentation has been a prime factor in the beneficent advances of modern medicine, the problem of assuring freedom of research still confronts medical investigators. Persons who do not enter the laboratories in which they declare animals are cruelly tortured, who do not see the operations they criticize, who do not know about different degrees of effective anesthesia, who are unaware of the history of medical progress and of the incomparable benefits to mankind conferred by modern medical discoveries, who are indifferent to the dire problems still presented by diseases which continue to kill their thousands and tens of thousands—these persons, combining real ignorance with unchecked imagination, spread dark suspicions and insinuations about honorable men whose lives are devoted, through research, to the relief of human ills. Furthermore, these misguided humanitarians endeavor, by harrowing and misleading descriptions, to rouse the public to a degree of hostility that will result in either seriously limiting or completely abolishing the most efficacious means of advancing medical knowledge. Leaders in universities and medical schools who, during the past half-century, have fought against the foes of liberty of learning have thus far preserved that liberty—to the inestimable advantage of future generations. The fight will not cease, however, so long as there are groups

of our population who would stop animal experimentation even though it releases mankind, and lower animals as well, from wasting disease, avoidable pain, and premature death.

Struggle against the common enemies of man—disease, pain, and early death—turns attention to the disastrous co-operation of these enemies with warring hosts when nations battle against nations for supremacy. The terrible devastation now going on in Europe and the fear of more extensive spread of the catastrophe have included medical research in a warping of scientific activities away from untrammelled pursuits toward problems of military significance. In our country what may be the consequences for men engaged in medical investigation? The answer to that question appears to be closely related to what may happen abroad. It seems probable that for years to come the need to repair the wreckage and the appalling waste resultant from the present titanic strife will leave European nations in such poverty that scientific studies will be sadly slighted. Whether or not the Western Hemisphere becomes involved in the conflict we are likely to find our associations with the Latin American nations south of us more and more intimate. In the past these nations have looked to Europe for medical training. Recently, however, they have begun to turn to the United States for instructive experience and discipline, both in the clinics and in the medical sciences. Circumstances indicate that this trend will continue and, as time passes, will become more prominent. The opportunity thus presented for medical investigators here to exert a stimulating influence in countries where hitherto relatively little investigative activity has been going on may have far-reaching effects. The need for development in these countries should not be criticized. We should remember that our own participation in the advancement of science has been recent. In relation to the medical sciences it may be recalled that the first experimental laboratory in our country that was avail-

able for medical research was established only seventy years ago. Before that period, what De Tocqueville wrote in 1850 was still pertinent—"that among civilized people of our age there are few in which the highest sciences have made so little progress as in the United States." We were fairly charged with collecting the treasures of the intellect without taking the trouble to create them. Although not many important centers of medical research have been established in South America, De Tocqueville's charge cannot properly be transferred to all that continent. The achievements of the laboratory of physiology at Buenos Aires, for example, admirably illustrate the capacity of Latin Americans to become deeply concerned with medical problems and to bring to fruition studies of first-rate importance. To some extent we have opportunity to send our promising young investigators to profit by experience with our Spanish-speaking colleagues. To a larger extent, experts in research in our university medical schools face the happy prospect of performing for enterprising candidates for careers in productive scholarship, who come from countries south, the same sort of stimulating service which European leaders in the medical sciences performed for ambitious American doctors two or three generations ago. No more effective means could be devised for strengthening the bonds of fellowship and understanding between the United States and its southern neighbors.

Finally we may note that a highly important problem which faces medical investigators is that of filling their own ranks. The young men who enter medical schools nowadays are often well disciplined in the basic studies and therefore are prepared to enter one or other of the pre-clinical departments to engage in research. Indeed, inquiry shows that not a few medical students participate in an investigation before they receive the doctorate, and some of their published discoveries have proved

important. As a rule, however, the youth who starts on the long road to a career in medicine has set as his goal his service as a practitioner. If he is enticed away from that purpose he may be made unhappy in regretting that he did not pursue his original aim. And yet, if the pressing problems of disease are to be solved, they must be solved by the devoted labors of men who single-mindedly apply their talents to such tasks. What are the rewards, the satisfactions, which a medical student may anticipate if he decides to spend his life in striving for further insight into the mysteries of the organism and the perturbations which it suffers?

First of all, it is a life of adventure. William Harvey, among the foremost physiological discoverers, expressed, more than three hundred years ago, the spirit of research when he wrote:

It were disgraceful, with this most spacious and admirable realm of nature before us, and where the reward ever exceeds the promise, did we take the reports of others upon trust, and go on coining crude problems out of these, and on them hanging knotty and captious and petty disputations. Nature is herself to be addressed; the paths she shows us are to be boldly trodden; for thus, and whilst we consult our proper senses, from inferior advancing to superior levels, shall we penetrate at length into the heart of her mystery. . . . Truly in such pursuit it is sweet not merely to toil, but even to grow weary, when the pains of discovering are amply compensated by the pleasures of discovery.

Regret has been expressed that here in our country the frontier with all its possibilities of fresh experience has disappeared. That is true in geography but not in science. All that one need do to come into direct contact with border ways and conditions is to step inside an active laboratory where experimental researches are in progress, and there, in the zone separating the known from the unknown, is a frontier which offers all the excitement and thrill of testing projected hazards. Beyond that

frontier is a realm of ignorance incomparably more vast than any which the lands and waters of the earth ever enticed a man to explore. Penetration into that illimitable territory is, to be sure, difficult. It is beset by many chances of error; but, as once was true of our Western border, it holds forth enticing opportunities for fruitful discoveries and it exacts rigorous qualifications of those who would venture therein.

Initiative and resourcefulness, enterprise and independence, ingenuity and skill—all are called into action. Because every discovery becomes the basis of further discovery, imaginative insight, to catch the dawning significance of a fresh revelation, is constantly stimulated. New facts suggest in turn other facts and point to unsuspected relations between phenomena which have long been known. Thus, though the investigator's interests may at the moment seem narrow and restricted, they may nevertheless lead his thought outward into unpredictable ranges of knowledge. These excursions of the imagination offer again and again suggestions for fresh adventure. The look, therefore, is always forward to what may be seen when the next step is taken. Seeking new things becomes in time a fixed habit. Past successes neither furnish contentment nor hold attention; they become fused with the established routine of existence from which it is a happiness to escape. The chance of beholding unsuspected wonders, or the demonstration that something imagined is really true, is a continuous incitement to further search, and furnishes the zest and interest which are among the greatest of the rewards.

Sometimes an investigator has the satisfaction of seeing a direct practical outcome of his studies. The question may be raised as to whether, in that respect, research in the medical sciences does not offer a considerable advantage over research in other natural sciences. Too often increased knowledge of natural forces, acquired by scientific studies, has been employed in

harmful as well as in beneficial ways. To these balanced consequences, good and evil, the consequences of medical investigations, as previously noted, are in striking contrast. It would be difficult, if not impossible, to find that any one of the many important discoveries made in the medical sciences during the past hundred years has been used by fighting forces for the destruction of life or for doing harm to the enemy. Instead, medical investigators, by learning the nature and cure of malnutrition, by devising appropriate treatment for shock and hemorrhage, by discovering varieties of local and general anesthetic agents and by gaining control of infections, have immensely mitigated the torments and ravages of warfare.

There is another consideration eminently creditable to the efforts of medical investigators. Because life and health are precious and medical research is deeply concerned with protecting life and health, the triumphs of that research are put to use without regard to any national or racial difference. There is no escape from the succor which they bring. Even though the beneficiaries may despise their benefactors, they must receive the benefactions. Is a follower of the Fuehrer bleeding to death and desperately dependent on a blood transfusion? His life is saved by methods discovered by Landsteiner, once an Austrian. Does a Japanese complain of a bewildering dizziness caused by disturbance of the internal ear? He will be in debt to Bárány, a Hungarian investigator. Does an Italian doctor wish to know whether a patient has typhoid fever? He applies observations first made by Widal, a Frenchman. Is one of our children in danger of diphtheria? His resistance to infection is tested by a process invented by Schick. Goldberger, an immigrant to New York's East Side, provided a simple preventive and treatment of pellagra, which made possible lifting, from hosts of miserable people, the blight of that dreadful disease. And no matter in what country they may be, the tens of thou-

sands of victims of syphilis must rest their hope of relief on a method of diagnosis first devised by Wassermann, and on a curative method discovered by Ehrlich, both Germans at a time when Germany recognized, without contempt and malignity, the value of ingenious devotion to human welfare. All these contributors to medical knowledge have been citizens of various lands, but they would all be classed as belonging to one people. And though in the last years their people have been again savagely and sadistically persecuted, no nations, however hostile, can take from these medical representatives the honor and glory of having served as saviors of their fellow men.

The attractions and the rewards of medical investigators have been described in some detail because the problem of filling the ranks of those who engaged in medical research is of primary importance. Unless the ranks can be kept unbroken, unless well-equipped recruits can be attracted to the career of the investigator, progress ends. The opportunities for long-enduring service to humanity should be widely known. Gifted young men should be aware of the chances which are opened to them and should prepare themselves accordingly. Universities should remove any financial obstacles which may confront the productive scholar looking forward to decades of medical investigation. The conquest of a disease, it should be remembered, is a permanent conquest. Humanity will be protected thereby through indefinite future time. An immortality of blessed memory awaits those who bring to mankind further respite from debility and pain.

Human Resources

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FOR A CENTURY and a half the United States has justified its existence as a nation by providing a good life for good people. Doubtless we as a nation have made many and serious mistakes. Doubtless by greater wisdom we could have done much better. But, on the whole, ability and industry have been well paid; careers in government, the professions, the fine and useful arts, business and other occupations have been open to merit; undeserved misfortunes have been largely prevented by free land, free schools, pure water, preventive medicine, and other protective measures, and have been relieved by public and private charity. With relatively few exceptions, the able and good from all over the world found in the United States a chance for life, liberty, and the pursuit of happiness.

It is one purpose of these conferences to help to maintain and improve our nation's record for welfare, in so far as universities can do so. And it is the purpose of my contribution to present certain facts about the use of human resources (i.e., men and women, and their capacities, habits, purposes, and ideals) to that end.

The welfare of a community, that is, the goodness of life for good people in that community, can be measured by a composite index made up of thirty-seven items of fact, such as the infrequency of death in infancy, the infrequency of death from typhoid, the per capita public expenditures for teachers' salaries, textbooks, supplies, and libraries, the percentage of persons six-

teen to twenty years old attending school, the infrequency of illiteracy, the infrequency of extreme poverty, the infrequency of work for wages of boys and girls ten to fourteen years old, the frequency of ownership of homes, of automobiles, and of radios, the frequency of domestic installations of telephones, electricity, and gas, and the infrequency of deaths from automobile accidents and homicides. I shall call the weighted composite index computed for any community from these thirty-seven items its G score.

The goodness of life for good people in the year 1930 in each of the 469 cities of 20,000 or more population has been measured by this G score; and the influences of physical advantages, wealth, income, character of the municipal government, the personal qualities of the population, and other features of a community upon its G score, or welfare score, have been studied. By the little known, but thoroughly sound, method of multiple correlation, it is possible to measure the influence of any one feature independently of all the others. For example, we can measure the influence of the per capita value of the taxable property of a community upon G, the goodness of its life for good people. In and of itself this value, I may note, is at or near zero. Only in so far as the value of taxable property per resident raises the income per resident does it promote welfare.

The two main causes of G, or welfare, are certain desirable personal qualities of the residents and their per capita income. Five-sixths ($83\frac{1}{2}$ per cent) of the variation among cities in G is due: to these personal qualities, as measured by an index P, which I will presently explain; to the per capita income, as measured by an index I, which also I will presently explain; and to things that P and I have in common, probably such things as intelligence about work, expenditures and investments, prudence, thrift, industry, and other business and industrial virtues.

Physical advantages, as of harbors or water power, the character of the government, the purely physical health and strength of the residents, and all else account for only one-sixth of the variation in welfare among these communities, except in so far as they are causes of the P or I score.

The personal qualities score, P, is a composite of the following eleven items with weights as specified:

ITEM	APPROXIMATE WEIGHT
Per capita number of graduates from public high schools in 1934	1 1/2
Percentage which public expenditures for the maintenance of libraries was of the total public expenditures	3/4
Percentage of illiteracy (reversed)	7/8
Percentage of illiteracy among those aged 15-24 (reversed)	1
Per capita circulation of public libraries	1 2/3
Per capita number of homes owned	1 1/2
Per capita number of physicians, nurses, and teachers minus male domestic servants	1 1/4
Per capita number of telephones	1
Number of male dentists divided by number of male lawyers	2/3
Per capita number of deaths from syphilis (reversed)	1
Per capita number of deaths from homicide (reversed)	1

The P, or personal-qualities, score is thus presumably rather closely related to the intelligence, morality, and care of the family of the community's residents. And facts could be added to support this presumption.

The I, or income, score is a composite of the following items with the following weights:

ITEM	APPROXIMATE WEIGHT
Per capita number of income-tax returns of \$2,500 or more (average of 1930 and 1931)	15
Per capita number of income-tax returns of incomes exceeding \$5,000 (estimated from the data for counties)	7
Average salary of high-school teachers plus average salary of elementary-school teachers	3
Average salary of full-time employees in all retail stores	5
Average wage in manufacturing plants	6
Average rental (or equivalent in case of homes owned)	3
Per capita sales of retail food stores	4
Per capita sales of cigar stores	1
Per capita sales of drugstores	1

There is good reason to expect that if the actual incomes for every individual were available for the computation of actual per capita incomes for each city, they would parallel the I scores for the cities rather closely.

Whatever inaccuracies and inadequacies may afflict the P and I scores will only strengthen our case; for their removal would raise the percentage of the variation in welfare attributable to P and I.

Personal qualities count more for welfare than income does. In the case of the 295 cities of from 30,000 to 500,000, I by itself alone accounts for 23 per cent of the variation in G. I by itself alone means I uninfluenced by what is measured by P. The 23 per cent due to I by itself alone is presumably caused by natural advantages, such forces as centered certain industries profitable in 1930 in Detroit, such forces as led certain possessors of large incomes to retire to Pasadena or Santa Barbara, and the transmission of wealth to the residents of a community by their parents, whose personal qualities do not count in the P score of 1930. P by itself alone accounts for 37½ per cent of it. P by itself alone means the factors in P which do not influence I, or influence it unfavorably, such as love of the fine arts, generosity to the unfortunate at home and abroad, intelligence not used to get or save money, honesty when it is not the best policy, and the like. What P and I have in common (and this is probably largely four personal qualities—intelligence in money matters, prudence, thrift, and industry) accounts for 23 per cent of it.

It is conservative to reckon that the personal qualities which do not influence income, plus those which do, account for over half of the variation among cities in welfare.

Closely similar facts appear in the case of the forty-eight states. Using indices of G, P, and I which are closely similar to those used for the cities, it is found that I (per capita income score) by itself accounts for 14 per cent of the variation among

the states in G. P (personal qualities) by itself accounts for 46 per cent of it. What P and I have in common accounts for $23\frac{1}{2}$ per cent of it. All other influences together account for only one-sixth of it, the same as in the cities.

The personal qualities which do not increase income, plus those like intelligence and industry which do, may be estimated very conservatively to account for over three-fifths of the variation among the forty-eight states in welfare. There is good reason to expect that among nations also, half or more of the variation in welfare is due to the personal qualities of the citizens; to human resources.

These human resources are partly given to man by nature, inborn, contained in the human sperms and ova, and perpetuated in our offspring. They are partly developed by man, acquired, contained only in the neurones of a person's brain, and passing away with him except as transmuted into things he makes, ideas he promulgates, institutions he establishes, and other changes in the material and spiritual environment caused by his life and work.

I shall use the short and convenient term, *genes*, to mean the arrangements of structures and collections of chemicals which constitute the determining features of a fertilized egg, in this case the egg of *homo sapiens*. The extent to which the genes determine the personal qualities of a population has been studied extensively, and fairly adequately, in the case of the quality of general abstract intelligence that is measured by examinations or tests devised by psychologists, and especially by Terman of this University. A reasonable estimate is that the amount or degree or level of intelligence of this sort manifested by a person is determined about three-fifths by his genes, independently of the environment, and about one-fifth by factors which are common to his genes and his environment and which cause good genes to go with good environment. This fifth probably should

be credited in large measure to the genes, since the genes presumably are largely primary in it, creating, selecting, or tolerating the environment where they are found. One-fifth is determined by the environment *per se*, including accidents. These estimates are approximately those of Shuttleworth's analysis, but with somewhat more attributed to the environment. Much more has been attributed to it by Hogben, but only because of his indefensible assumption that the correlation of the Otis Advanced test with another independent test of intelligence will be as high as .97.

It seems probable that mental health, freedom from hysteria, psychoses, and neuroses, the control and balance of bodily appetites, consideration of the wishes and welfare of others, and other features of desirable mental resources are dependent upon the nature of the sperm and ova to a large extent, though not so large as in the case for intelligence.

The particular uses to which intelligence is put, the particular forms that delusions take, the particular restraints which men impose on themselves, and the particular indulgences which they choose, the concrete ways in which they show their good will toward men, and other directions and specifications of inherited abilities and wants, are very largely dependent upon the environment, the life of one's family and neighbors, the culture or mores of one's tribe or class, the intellectual and moral climate of one's nation and epoch. These particular ideas, acts, and attitudes may be likened to the capital goods and consumer's goods into which the same physical resources of minerals, plants, and power have been transformed in different places and at different times. The genes in the germ cells may be likened to the sunshine, soil, coal, oil, waterfalls, animals, and plants. They may be likened with full exactitude to the seeds of plants and the eggs of animals, for they are like them in every way.

If we could inspect the germ cells which will so largely create our country's future mental resources and had full and exact knowledge of their potentialities, we should find a wide variety—not so wide as there will be after thirty or forty years of life, but still ranging from imbecile to near genius, from brutality to nobility, from near devil to near saint, from silly hysteria to self-control, from worthlessness to high value as parent, neighbor, or citizen.

We know far too little about these potentialities; but we know enough to be sure that the perpetuation of certain genes and combinations of genes is an absolute guaranteed contribution to welfare, and that at the other extreme are combinations of genes which will do far more harm than good by being born. We know that both good and bad genes and gene combinations will appear very widely in a population, but that on the whole like produces like. The variation among the germ cells of the same parents is four-fifths as great as the variation among all the germ cells, so that the able and good may have weak and evil offspring. But they have far fewer of such than ordinary parents have, and almost none in comparison with what weak and evil parents have. Since we can turn germ cells into persons only via parents, we know that the improvement of our human resources depends largely upon the degree to which the able and good have children and keep them alive. The bitter and lamentable fact is that they have fewer than their inferiors and that the greater longevity of their children will not make up for their scarcity. From 1800 to 1930 in this country the number of children born per year per thousand women fifteen to forty-four years old dropped rather steadily from about 275 to about 80. As a rule the decline began at the top of the mental and social scale and has been proceeding to lower and lower levels, but also to smaller and smaller families at the higher levels. This sort of change seems destined to be worldwide. It seems, indeed,

to be becoming so already. Among classes or groups, and among individuals within a group, the rule is that the superior give up their share in the future first. The ignorant, careless, and incompetent increase their share relatively.

It is the fashion among many sociologists and reformers to evade the reasonable conclusion that the genetically inferior elements of our population are producing their like at a rate above that of the able and good, and to consider one or another affiliate of the high rate among the former as its cause. In the case of inferiority in intelligence they are surely wrong. Measurements of the intelligence score of a child and the number of brothers and sisters that he has, have been made by Bradford, Sutherland and Thompson, Chapman and Wiggins, Terman, Dawson, Lentz, Thurstone and Jenkins, and O'Hanlon. Their measurements give for completed families negative correlation coefficients averaging somewhat over .20. For example, Sutherland and Thomson found the number of children surviving (long enough to be reported as alive by their 11-year-old brother or sister) to be about one and one-half times as large for the bottom 25 per cent of children found in schools as for the top 8 per cent. Thurstone and Jenkins found among children brought to the Illinois Institute for Juvenile Research for examination that those with I.Q.'s of 50 to 69 came from families having about 1.6 times as many children as was the case for those having I.Q.'s of 130 to 139. Those with I.Q.'s under 50, however, the idiots and pronounced imbeciles, came from fairly small families. Giving birth to an obviously idiotic child seems to cause some restraint. Lentz found from records of 4,330 children in New York, Connecticut, and Missouri that the average number of children in the families belonging to children with I.Q.'s under 60 was over two and one-half times that for the families belonging to children with I.Q.'s above 150. The 5½ per cent with I.Q.'s under 70 showed over two and a quarter

times as many children per family as the 3 per cent with I.Q.'s above 140.

O'Hanlon, working under the direction of Godfrey Thomson with data collected by Dawson, has studied the influence of room space, nutrition, and family income, and finds that "the cumulative effect of the components of the environment makes very little difference to the negative correlation between I.Q. and size of family."

The relation between the average intelligence of all the children in a family and the size of the family will be worse than that shown by these figures. For the use of the intelligence of only one child tested by only one examination attenuates the correlation coefficient appreciably. If Thomson, Dawson, and the rest had had the scores of all the children in each family, and had used several examinations at various dates for each child, the families forming the lowest tenth in intelligence would have accounted for more than twice as many of the oncoming generation as the families forming the highest tenth in intelligence.

The birth rate for persons afflicted with certain sorts of mental diseases has been studied recently (1935 and 1938) and extensively by Erik Essen-Möller and by Franz Kallman. The former finds that manic-depressives differ very slightly from the general population, and schizophrenics with manic-depressive symptoms slightly, but that epileptics and schizophrenics in general have greatly reduced families. Kallman finds the birth rate among schizophrenic insane on the whole substantially lower than that among the general population, though it remained high among those of the paranoid type.

The matings that produced Kallman's schizophrenics showed on the average nearly $4\frac{1}{2}$ children, which was near the average for the general population of their time and place. Much the same is true of the insane-producing matings reported

by Heron, by Rüdin, and by Dayton. All these data antedate widespread birth control; its effect upon the producers of offspring susceptible to mental diseases may be better than upon producers of those weak in intellect.

Concerning the selective birth rate in relation to other resources than intelligence and sanity I have little to say. Slawson's families of boys confined in New York state reform schools seem larger than the average for New York state. Thurstone's families, whose children are brought to the Illinois Institute for Juvenile Research, are presumably on the whole inferior in mental health and balance; they averaged 4.13 children, including incompleated families.

More adequate investigations of the relation between size of family and objective indices of such desirable qualities as mental health, self-control, and kindliness are very much needed. Until such are available we may hope that the state of affairs for some of these is better than for intelligence, but we must fear that for some it is worse.

We may hope in general that as birth control spreads to include the dull, ignorant, and incompetent, the birth rate may equalize itself for all classes, or even become selective in favor of the superior. It will be wise, however, to do something besides hope.

There is perhaps little that universities can do to swing the selection of the birth rate toward a preponderance of the able and good. They can at least become aware of the importance of the matter. Up till now many trustees, presidents, and heads of departments of universities have considered the children of teachers as liabilities, if they considered them at all. To the best of my knowledge no university has ever reported the birth rate of its faculty! They can at least consider the probability that in a man of great ability sterility is a more objectionable anti-social trait than many of the political or religious eccentricities

which they have viewed with alarm. There is some evidence that even small additions to salary as regular allowances for a wife and for children are effective in the case of young instructors. It seems likely also that social approval of the large family by the leading men and women in a university community might, if sincere, do some good. University women may perhaps help to break the vicious circle in which estimable people have few children, so that having few children is esteemed, so that estimable people have still fewer.

However, nothing should be done that would distract universities unduly from their primary duties of advancing and diffusing knowledge. If a man's intellectual achievements will be reduced by marriage and parenthood, the price may not be worth paying. Such a case will be exceedingly rare; on the average the babies will be a better contribution than the books that would have been written if the babies had been avoided. It would have been a very bad bargain if Erasmus Darwin had avoided parenthood in order to write more poems and a sequel to *Zoonomia*.

There is one special service which the departments of biology and medicine of a university may undertake, namely, a program of research on the prevention or cure of involuntary failure to produce viable offspring, which is far commoner than most of us have realized. According to Myrdal, over a tenth of the cases of sterile marriages are involuntary. The percentage may be less for the able and good, but even a small number of superior men or women who wish children but cannot have them represents most lamentable personal misfortunes and social losses.

Until the genetic supply of human resources is improved, and even after it is improved, we must utilize what we have as best we can. Government, business and industry, the family, churches and schools, and all institutions have the task of using

human genes to maximize welfare. This is roughly half the entire task of civilization, and is comparable to the other half—of using material or nonhuman resources to the same end. Naturally, in less than half an hour I can discuss only a few bits of it.

We can protect our human resources from scarlet fever and other damaging diseases of childhood and put vitamins in their food. We can fill their live teeth and extract their dead ones, or by other and better means prevent certain infections. We can abolish or reduce enormously the wastage from malaria, tuberculosis, and syphilis. Perhaps in the future brains and souls may be improved by physical, chemical, and biological agents in ways and to degrees now unknown and even unsuspected.

The minds of men may or may not be greatly improvable by chemicals, radiations, and the like. They certainly are appreciably improvable by education and conduct. The doses of experience that they receive through eyes and ears stimulate their activities and change their natures; many, perhaps all, of the acts that they do in response to stimuli change the persons as well as the face of nature. The mental and social environments, from the caresses and warnings of the mother in infancy to the arts and letters and sciences of the university, change human resources widely and deeply, and often for the better.

Experience, action, and the rewards and punishments which various actions in various circumstances receive from the physical and social environment reach their most civilized and humane status in man's learning, appreciation, and use of the arts and sciences. These improve human resources in two ways.

As we all realize, they give man knowledge of the physical world, of the life and ideals of men, and of languages or systems of symbols. They also, as we do not always realize, give him mental tools to operate with in thought and action. Ge-

ometry gives us not only truths about space and its dimensions but also tools for thinking about it, communicating with others concerning it, and adapting ourselves to it. Physics and chemistry not only reveal the constitution and behavior of matter but also give us equations which are as truly tools for action as hoes, plows, levers, and magnets. They are also the father and mother of our more obvious tools for power, light, transportation, and the like.

In the natural sciences the tools are derived from the principles, but in certain important parts of our culture, that is, our environment of ideas and customs, the principles are derived from the tools. Thus, the law has developed primarily as a majestic tool to encourage and enforce certain ways of living and conducting business. The facts and principles which rationalize the tool are those set forth in a "science" of law in much the same way as facts and principles of a "science" of grammar are set forth to rationalize reputable usages of that potent universal social tool, language.

Certain beliefs and customs, moral and religious and esthetic, are social tools of great power, with very inadequate facts or principles to support them. Such, for example, are the belief in the power of the Church to influence one's fate after death, the "live and let live" doctrine of liberalism, the doctrine and practice of contract between free individuals in place of status within a family or feudal organization, the customs embodied and made authoritative in the common law, and universal suffrage. When these beliefs, customs, laws, and creeds concern matters of value rather than matters of fact, and they usually do, the physical, social, and historical sciences have rarely made claim of power to improve them. And these sciences do not directly and automatically improve these tools of belief and custom for dealing with rights and wrongs, goods, betters, bests, bads and worsts, goals and pitfalls, desirables and detestables in the way

and to the extent that the physical sciences improve the material tools of agriculture, manufacturing, transportation, or communication. But they could be potent influences.

They could be means for changing and improving purposes and ideals; and purposes and ideals are surely as important resources for welfare as ability and knowledge are. The original human nature contributed by the genes in the ovum and sperm contains purposes and valuations (wants, appetites, drives, propensities—call them what you will) which can be transformed into nobler and more humane ones. Some mothers learn to value the welfare of other children than those they nurse and fondle. Some men learn to value truth more than toys. I believe that the improvements made in our wants, purposes, and ideals (in our valuations, to use a single word) should be guided by a science of valuation, and that the universities should at once do what they can to foster such a science. I ask your attention to a statement of the matter which will for brevity's sake be dogmatic, but which I could defend if I had time.

It is not necessary to leave these social tools that involve valuation at the mercy of individual enthusiasts, not to say fanatics, or waves of popular feeling. There can be natural observational and experimental studies of values. Such studies would accept as a fact, or as a most useful assumption, the axiom that all values are functions of the wants and satisfactions of sentient beings—animals, men, angels, or deities, existing now or in the future. The data for determining the value of an idea, act, custom, law, or creed are then entirely covered by a description of its consequences in increasing satisfactions and decreasing frustrations and miseries. These increases and decreases are matters of fact to be studied by science. There are millions of them, so that their determination may be exceedingly laborious. The value of an idea, act, custom, law, or creed as per these consequences will vary according to the weights

that we attach to the satisfactions of men and those of animals, or angels, and according to the weights that we attach to the satisfactions of certain men in comparison with others. But for any given set of consequences and any chosen set of weights there is a determinable value. We do not need to flee from science and history to Moses or Mahomet or Marx to get values to rule our lives. Nor should our admiration for greater seers and prophets than these prevent us from supplementing the rules of valuation which they have set forth, by investigation of their consequences.

The universities have, in general, been timid in investigating values, preferring rather to inform the young concerning the opinions about values put forth by eminent philosophers and literary men than to accumulate facts and principles concerning problems of valuation.

Experts in economics have restricted their study of the consequences of acts by considering exclusively or chiefly those things and services that are bought and sold, by neglecting moral differences between the same want in different persons, and between different wants in the same person, and by fleeing from values to prices as quickly as they can. Such restrictions they have a perfect right to make. But some science should go beyond them. Experts in anthropology, history, sociology, and law have, in general, avoided the study of values. They have done so for various reasons, only one of which will be considered here. That is the absence to date of any reasonable and acceptable system of weights for different wants and different individuals. The weights used, avowedly or tacitly, by European civilization of the nineteenth century were far from clear or compelling, but we have lost confidence in them without finding any acceptable substitutes.

It is fundamental for a natural science of values that we should study the relative weights to be attached to the wants

of sane and insane, men of genius and idiots, producers and idlers, the living and the dead and those yet to be born, animals, men, and deities, and many other arrangements of persons along relevant scales; and to the wants of each for water, milk, alcohol, security, adventure, glory, companionship, affection, sex-activity, various forms and amounts of schooling, entertainment and play, liberty, equality, and fraternity, approval, self-respect, truth, justice, and all else.

A system of weights which would be a true system in the sense that the Copernican system of the motions of the heavenly bodies was true, is perhaps unattainable, but I venture the prophecy that the same criterion of consequences applied to weights will advance knowledge as truly, if not as far or as fast, as when it is applied to acts and customs.

A natural science of values will, in my judgment, provide both systematized knowledge to interpret and supplement the facts of the social sciences, and tools to improve human ideals and purposes. Should not men of science and scholarship in the church and in the universities accept the challenge and build something to replace outworn codes, the illogic of hopes and fears, and the fantasies of prophets?

By changing the material and spiritual environment we can improve the achievements of our intellects and characters. This is done especially by improvements in the bodies in which they live and in the ideas and habits and purposes that they have, including those stimulated and maintained by a science of values in addition to the sciences of things and events. Can we hope also to improve the more fundamental qualities of men, other than by selective breeding? Can we hope within each generation to make men more reasonable, humane, and competent? The answer is that we can, but with very important limitations.

The current gospels concerning the ways and means of

radical transformations of human nature seem to me very questionable, or even fantastic. I cannot expect with Freud to make men generous by causing their bowels to move freely in infancy. Nor, in general, can I expect that we shall get much deeper and broader changes in human nature by attacking it in early childhood and infancy. I cannot expect nearly as much from the so-called discipline of the mind in schools as most of you probably expect. I cannot, for example, expect with my revered former colleague, Calvin Thomas, that the study of German results "in the upbuilding and strengthening of the scientific intellect," or with Woodrow Wilson that "the mind takes fiber, facility, strength, adaptability, certainty of touch" from "mathematics, Latin, and Greek," or with some of my scientific colleagues that using the scientific method in the laboratory will purge the mind of all its tendencies to emotionality and prejudice. Various forms of supernaturalism and mysticism which claim to release hidden powers of the soul, or even to create new powers in it, do not arouse my enthusiasm.

I have hopes of human betterment through advances in knowledge of biochemistry and especially in knowledge of the hormones which the body makes; but I fear that intelligence, humanity, and competence will remain largely beyond chemical control. I fear that they are largely cumulative results of ideas and habits. Therein consists the limitation referred to earlier. The genes give or withhold certain fairly general capacities whereby Aristotle differed from an idiot, George Washington from a bum, Jane Addams from Madame Pompadour; but education has to work piecemeal with details, implanting ideas and forming habits, changing the particular responses to particular situations.

The methods by which we may hope to change the inherited powers and appetites of men are the tried and true, slow but sure methods: first, of selecting the best from a man's responses

to a given situation of life; and, second, of shifting a given response from some situation where it does harm to a different situation where it does good. These methods, which we rely on to form habits, should be our main reliance in changing powers, appetites, and personalities.

We cannot attach a response to a situation unless and until we get the response. If a person in a certain situation thinks or does nothing that is reasonable, we cannot make him a more reasonable being by selecting from his thoughts and acts. If he has no kindly impulses, we cannot improve him by shifting these more and more widely to his neighbor, to his countrymen, to all men. All that we can do is to stimulate the occurrence of certain acts, thoughts, or feelings and connect them with situations or states of affairs where they are beneficial.

Stimulating the occurrence of the desirable act or thought or feeling in the premises is often impossible and usually difficult. The older reformers, such as Bentham and John Stuart Mill, underestimated the difficulty. They thought of men as rational beings like themselves and assumed that men could by reason decide that such and such should be thought or done, and would then be moved to do it. But men like Jeremy Bentham are very rare birds. Few men proceed from knowing that a thing is right to doing it. Fewer still proceed from knowing that a feeling is right to having it. On the contrary, the usual course is to proceed from having a feeling to thinking that it is right.

The older pedagogy and ethics expected far too much from commandments. Orders to "Think," "Be reasonable," "Don't let your mind wander," "Be brave," "Be patient," "Keep up your courage," have no intrinsic potency whatever. They evoke only the responses that have been connected with them by repetition and reward. It often requires great ingenuity to maneuver a person into having a certain idea, and it almost always requires great ingenuity to lead him to have it at the right time;

and it requires still greater ingenuity to maneuver him into responding to a state of affairs by a desirable act, and even greater to lure him into responding by a desirable emotion or attitude.

Once he does so, we usually must strengthen the tendency by repetition and reward. Connections made in the mind become stronger the oftener they recur and the oftener they are rewarded. By reward is meant enough satisfyingness to the person concerned to incite the confirming reaction. The confirming reaction is the main force by which a man modifies his own intellect and character to suit his ideals. It is the main force by which society modifies its individual members. It is aroused to action by any event which satisfies the ruling state of mind; it strengthens whatever connection has just occurred. (Not, however, infallibly, since it may spread or scatter to influence some earlier or later connection.) On the whole, and with a margin of error, it causes a person to do what makes him comfortable then and there; it need not make him or anybody else more comfortable in the long run. But it can do so if directed by adequate human engineering. On the whole and with a margin of error it adapts him to his physical and social environment; within that environment it need not favor reality over appearance, or truth over error, or welfare over ruin. But it can be made to do so by adequate human engineering.

Increasing welfare by improving roads, machines, or crops is an easy task compared with increasing it by improving man himself, either by selective breeding or by directing the forces of repetition and reward toward proper ends. But we at least know the way.

It has been one of the triumphs of science and the industrial arts to cause men to adapt themselves more and more to realities rather than to comfortable fictions, and to the whole course of nature rather than to the spell of the moment. But in the sciences of man we have a long way yet to go. Until men learn

to welcome, or at least tolerate, a bitter truth more than a comforting lie, their welfare is precarious. Until they honor and obey the impartial truth-teller as much as the skillful entertainer, and more than the purveyor of interesting, flattering, and comforting opinions, they will be at the mercy of selfish rulers, misguided reformers, and false prophets of all sorts and descriptions. Only wise leadership can save them. If the confirming reaction in the minds of leaders in governments, churches, schools, business, and professions does not favor the truth about human nature and human purposes, there is little hope for human progress.

It was the duty of the early universities to preserve the truth; it has been an added duty of the present universities to increase it. Should it be the duty of the future universities also to make men, or at least the leaders among men, *love* the truth? Personally, I wish that the churches and the press would take much of this duty, so that the schools and universities might devote themselves mainly to preserving and increasing the truth for those who want it, without responsibility for advertising and selling it. This nation must find some competent group to accept the duty.

We have been fond of saying that truth is mighty and will prevail. But I fear that by any sound appraisal of human nature this holds good only to the extent that, other things being equal, truth will prevail over error, its harmony with reality then tipping the balance in its favor. We cannot afford to run the risk of leaving truth to defend itself and create its own adherents. We must, at least, keep the other things equal, and we should try to make them favor truth. If it is good and wise to use material wealth and human lives in the interest of freedom, it is better and wiser to use them in the interest of truth. Now, even more than in Chaucer's day, it is the highest thing that man may seek. Men and women who honor, love, and obey it are a nation's best resource.

New Products

CHARLES FRANKLIN KETTERING

Vice-President of the General Motors Corporation



I HAVE BEEN ASKED to speak to you tonight on the subject of industrial research. I think that before we can say much about the subject, it is necessary for us to define just what we mean by industrial research.

Industry is a form of organization that has to do with a product or a service. It doesn't make very much difference what the product or service may be. It's a method whereby skilled people in one section of the country can transmit their skill or handicraft to people in another part of the country. In agriculture the products are the fruits and grains of the field. It may be timber from a forest, or ore from a mine, or manufactured product from a factory. We have often said that the automobile and other things we make are simply the packing cases in which we ship the skilled labor of the automobile manufacturer to the consumer. The radio we buy in a store is simply a case in which are combined the skill and technical knowledge of the people who designed and manufactured it. What we buy is not only so many pounds of material but the result of years of experimenting and research.

It seems to me that the word "research" has been greatly misused. A research laboratory is nothing more than a procurement department for new ideas. What we're doing in a research laboratory is trying to solve a problem—the problem of finding out what we are going to do when we can't keep on

doing what we're doing now. Through research we not only improve the products we have now, but we investigate new products. This is very important, because it is only through new products that we can progress in the future.

Up until the beginning of the rearmament program, we had great excesses of men, money, and materials. All we lacked were enough projects to put these excesses to work. Over the last four or five years there has been a great deal of talk about our being too far advanced technologically, and we have seen a great number of papers published stating that technological development has thrown people out of work. All these theories were based on the supposition that research and industrial development had to do only with the invention of labor-saving devices; but in reality the greater part of them were concerned with labor-creating devices.

I have often answered this criticism of being too far ahead technologically by a little story which a railroad man told me a good many years ago. It seems that there was a man who sued the railroad because the train pulled out of the station fifteen minutes ahead of time. The railroad people insisted that the train had not left ahead of schedule, but the man wouldn't listen, so the suit came to trial. It was then proven by documentary evidence that the train hadn't left fifteen minutes early at all, but had been twenty-three hours and forty-five minutes late. In other words, it was the train of the day before. The same thing can be applied to our research: We are several laps behind, and people think we're ahead.

Is there any difference between the thing we call industrial research and the thing that is carried on in the great university laboratories? Someone once said that the only difference between pure science and applied science is about twenty years. Just as great a difference, however, is the fact that in academic research you are working on generalized principles, while in

industrial research we are working on specific cases. In a number of instances we have to disregard the general solution in order to reach our specific solution. It's a good bit like studying the general classes of fish, the different phases in a fish's life, and the location in which fish are found, to become a fisherman. It's nice to know all these general things, but it doesn't mean that you're going to catch any bigger fish than the fellow who doesn't know them. The specific solution of a problem is almost always a special case of the general solution.

As I said, we in research are concerned with the subject of products. One of our really important projects, for example, is the study of why our hands get warm when we rub them together. This phenomenon is very easy to explain, of course, by saying it's friction. Very well, let's find out what friction is. We can argue until we're blue in the face, but we finally have to admit that the only thing we really know about friction is that it's the thing that makes our hands warm when we rub them together. That's all we know about it. But the importance of knowing something more about friction is very great, because friction is the determining factor in the mechanical efficiency of all our mechanical devices.

Along with our study of friction, we are studying the prevention of friction, which is lubrication. Years ago, standard lubricating tables were compiled on the theory that a good lubricant would stand about five or six thousand pounds per square inch of projected area of the bearing. Those tables were accepted without question for many years. However, in the development of our hypoid gears, we were put into a position where we had to have lubricants that would stand up under pressures much greater than that. Well, how much better could we hope to do? Could we improve lubricants 10 per cent, 20 per cent, or 100 per cent? Before we had finished, we came out with something like 600 per cent improvement over the same

load of the older lubricant. This remarkable gain was achieved by drastically changing our ideas as to what constituted a lubricant.

Similar discoveries, whereby things have been made much better than the theory said they could, have been made by every industry in the United States. Another example of equal importance is the development of the material called permalloy or hypenik, in which the magnetic property is increased many times over that of pure iron, which at one time was supposed to be the limiting factor.

Many new types of lubricants have been developed through co-operative research between the automobile industry and the oil industry. These new lubricants are quite a remarkable improvement over the old lubricants, and they are producing almost unbelievable results. They are to the lubricating oil business what alloys are to steel. Anti-oxidants and detergents have been added to lubricants, so that they produce, under heavy duty, a better bearing surface. What all these improvements will mean in future designs, of course, can only be guessed at.

The question of paints is also very important. I can remember when automobiles were finished exactly like pianos, and we used to complain because the paint didn't stand up. Yet anybody would have thought his neighbor very foolish if he had subjected his piano to the same weather conditions as he did his automobile. To give you an idea of some of the advances we have made since those days, we have had for the last ten or twelve years a laboratory in Coral Gables, Florida, where we have been exposing our paints to the weather. This study was undertaken for the purpose of trying to find out why it is that paints in the South fade faster than those in the North. It was only natural to assume that this fading was due to the more intense sunlight, and quite a lot of data had been accumulated on

the subject of ultraviolet light. I have always doubted the importance of ultraviolet light in paint failure; so we developed a new type of measuring apparatus by which we could integrate the intensity of the sunlight over quite a long period of time. As the curves began to develop, it became evident that paint failure went up inversely as the sunlight intensity. That is, the less sunlight we had on the paint, the faster it failed. If it wasn't the sunlight, what could it be? Well, we finally agreed that it might be the dew.

So we set up three very elementary experiments. First, a normal set of panels; second, a set of panels with an electric light behind them so they could be kept warm and never have dew on them; and, finally, a set of panels which were surrounded by refrigerating coils so that they were always covered by an excess of dew. The failures took place exactly in proportion to the number of hours that the panels were covered with dew. Now, wetting a panel with dew is quite different from wetting it with a hose, because if there are small cracks in the paint and you wet it with a hose the water simply bridges over them; but if you wet it with dew, it wets the crack from the bottom up. After this simple experiment, we changed our whole point of view about what we should consider the basic part of a protective coating. Our point of view has now shifted from ultraviolet light to cracks and dew. As a result of this simple discovery I'm sure that still greater improvements in the already advanced paint technique will be developed.

Most of our problems have a definite "must" behind them, and we have to do something because of a certain condition. A couple of years ago we had a steel spring designed to do a certain job and later on we had to use it at a much higher duty than was originally anticipated. The best figures that we had showed that this spring, under normal operating conditions, would withstand about 2,000 cycles of stress before it would

break. We tried using alloy steel springs; but, though they were a little improvement, they still weren't good enough. Finally someone suggested that we shotblast a few springs by impinging very small steel balls, about a sixteenth of an inch or so in diameter, against the surface of the material.

After we had shotblasted these springs, we put them in a testing machine. The springs did much better than we had hoped. Instead of failing after 2,000 or 3,000 stress cycles, they broke down at 3,000,000—an improvement in the order of 100,000 per cent. Just exactly why these springs are so much better than ordinary springs is something we do not quite understand at the present time. We know that the shots close all the little cracks in the surface of the material by a sort of cold-working, and that is all we know. The important result of this development is that it shows we sometimes design too close to the book instead of designing for the thing we have to do. It is in these emergency cases, where we have to broaden our concepts, that the great advances are being made.

For the last twenty-five years I have been playing with powdered metals. When we first put the self-starter on the automobile, the only brushes we had that were rugged enough to carry the heavy current required for starting were the so-called copper-gauze brushes. These brushes weren't very satisfactory, however, because they scratched the commutator. So I took an ordinary copper-gauze brush and introduced some powdered copper into it, and the brush worked much better. Later on we succeeded in getting a brush which was almost all copper powder.

For a great many years we have been manufacturing small bearings from these powdered metals, and they have been made to absorb quite a lot of oil, so that a bearing for low duty can have enough oil in it to last for the lifetime of the machine. In this powdered-metal technique the question was brought up

as to whether we could make powdered iron. It wasn't difficult to get powdered iron, but it was difficult to get it at low enough cost. Today we are producing finished machine pieces made by the same machinery used for making pills and pellets.

In making gears, for example, we start with a die in the shape of the gear. This die is filled with powdered metal and compressed. The compressed briquet is placed in a furnace and heated to 2,000 degrees F., at which temperature it is sintered and has a somewhat higher tensile strength than ordinary cast iron. This sounds like a very simple thing; but the amount of work which was required to get not just powdered iron but *low-cost* powdered iron was considerable. We have always said that we are great believers in the fourth dimension. Most engineering problems have to take into account the length, breadth, and thickness; our fourth dimension is cost. We often feel that instead of calling it the fourth dimension, it should be called the first dimension, because we have got to design against cost if we're going to get a product that will meet requirements in its field.

Another difference between so-called industrial and scientific research is that in scientific research you have to contend with only the material and the energy relationships. But in industrial research we are faced with two more factors. One is the aforementioned cost factor and the other is the psychological factor. That is, we've got to work with the same material and energy relationships as the pure scientist, but we've also got to work with the customer at a cost that he can afford. In other words we have to take his buying and psychological requirements into account.

Some of the other important problems that have been in our laboratories for a number of years are those pertaining to fuels and engines. These two problems constitute the basis of the whole automotive industry. Development in both has advanced

considerably over the past five or ten years by a great deal of cut-and-try work.

One of the things that industry has to do is a lot of this so-called "cut and try." I was once asked if I could explain the difference between theory and practice. A friend of mine had told me at one time that the greatest advantage of practice was that it never let you forget anything. This fact was brought to my attention this winter when I was working on a certain job and a friend of mine said:

"I think you're foolish to do that work every day. Why don't you get someone else to do it for you?"

I told him I had never thought of that idea and that he might prove to be a great help to me. He happened to be quite a good golfer, so I said to him:

"Suppose you get somebody else to practice your golfing for you, and after you've learned how to make somebody else get your experience for you, let me know about it and I will get somebody to do this work for me."

There is a great difference between theoretical education and practical experience. You can read every book about golf that there is in the world, but unless you go out on the course and practice you certainly can't hope to win a championship match.

A great industrial leader once said to me:

"You boys don't do a good enough first job in your research laboratories."

"You're right," I said. "The jobs we do in the research laboratories are just the same sort of jobs that any amateur would be expected to do."

"But," he said, "you're not an amateur. Look at the facilities you've got."

"Well," I said, "what is an amateur? An amateur is a fellow who is doing a thing for the first time. The only difference between the ordinary amateur and the research worker is that

the research worker is a professional amateur. That is, he's an amateur in that he is doing a thing for the first time, but he's a professional in that he knows he's going to have a lot of trouble doing it. After we turn our first job over to the manufacturer it becomes a product. Because people use it in different ways than you expected they would, it must be re-designed and improved."

I have often wondered why people have such a strong negative attitude toward anything that's new. Perhaps the answer is simply this: We have been studying history and looking back where we came from so long we've forgotten that it is more important to know where we are going. If we tried to drive an automobile by the same method we have organized our civilization, we'd have the steering wheel facing out of the back window to see where we've been instead of where we are going. We are so used to looking backward that whenever we face a thing that requires looking forward, we resist it. I am a great believer in the future, because I know that we can make the future anything we want it to be. Whatever we set our hearts upon shall surely be ours.

It is very difficult to see what today's research problem is going to mean tomorrow. The story of the Wright brothers is an illustration of this fact. After they had made their first flight of 120 feet in 12 seconds at Kitty Hawk, they sent a telegram to their sister in Dayton telling her of their accomplishment. She immediately called up the newspaper and read them the telegram. The telegram read: "We have just made a successful flight. We are very happy and will be home for Christmas." After she had read it, the newspaper man said: "I'm glad to hear that the boys will be home for Christmas." That is the way every new thing starts.

I am not a pessimist. If we maintain a forward-looking attitude, our faith in the future will bring us whatever we hope the future will be.

American Writers and the Future

ARCHIBALD MAC LEISH

Librarian of Congress



IT WAS APPARENT even before this war began that there was a new world in being and that the existence of that world created obligations—obligations and difficulties—for those who followed the profession of writer. One cause of our disastrous difficulties was our failure to occupy—imaginatively and understandingly to occupy as only the writer can give us to occupy it—the world in which we lived. Certain scientific discoveries, certain inventions now commonplace, had altered not only the possibilities of the world but its actualities also: not only its dreams but its geography. And our failure to occupy, not only intellectually but imaginatively, not only practically but emotionally the world thus created, was in large part responsible for the maladjustment and insecurity from which we suffered. It is not physical nature alone which abhors a vacuum nor is it only air and water which floods in to fill the empty space. If men do not occupy for themselves the new continents the enemies of men will occupy them.

But if it was apparent even before this war that there was a new world in process of creation it is even more obvious now. There are some, I realize, who still find it possible to believe that the vast struggle of our time is nothing but another “European War” which we may notice or decline to notice as we please. They are not, however, people whose good judgment—whatever may be said for their good intentions—has impressed

their fellow citizens. Aside from this minority and a handful of equally earnest but decidedly less honest people engaged in propagandizing the sword-and-pistol Marxian theory of the Imperialist War, the great majority of our contemporaries believe that they have seen what they have seen and heard what they have heard. They believe, that is to say, that fascism is world revolution aimed at the overthrow not only of political systems and economic systems but of social systems as well and of the entire fabric of moral and cultural values upon which the world as men have known it for many centuries has rested. They differ only in this—that some of them believe the new order of discipline, authority, and war which fascism proposes to substitute, and has already in many places substituted, for these systems and fabrics is the true shape of the future and must therefore be accepted, while others believe the true shape of the future is the very different order of freedom, responsibility, and life which those who hate and fear fascism will be obliged to raise against it as a weapon of their own defense.

But neither those of the first opinion nor those of the second, nor any others who have watched this time with honesty and courage, doubt for a moment that the world we are in process of creating will be a world unlike the world which went before. Those who believe that fascism is the shape of the future can see their future mirrored in a dozen countries and in the faces of the men and women of a hundred once great towns. The rest of us, who believe that democracy, menaced by forces darker, bloodier, and more brutal than those which forced its birth, will of necessity become democracy again and labor and create, can guess our future also. Both worlds are very different from the world we know.

Those who follow the profession of writer seriously and honestly now and in the years which will follow these years will face therefore a great obligation and a great difficulty.

The central problem of any art, but above all of the art of letters, is the problem of the reduction of experience to form, and a revolutionary change in the structure of experience presents of necessity a revolutionary problem to the artist. The scientist who deciphers experience by abstracting from it absolute quantities can let his absolute quantities stand, however violently the reactions of men to each other and the earth may alter; and the philosopher who explains experience by fixing it in abstract terms may pin his abstract terms to the world's skin, however the world's skin wrinkles. The artist has no such freedom from change and time. His labor is the labor of translating one form of experience to another form of experience, and the second must change as the first changes. His labor is to communicate experience in such a way that, by the very act of communication, by the forms of art in which the communication is accomplished, experience itself is recreated—but recreated with coherence and made whole.

As experience alters, therefore, the forms in which experience is recreated and made coherent must alter also. But—and this is the heart of the difficulty—the alteration of forms is never free alteration, pure invention, but always an adaptation of the forms which went before. It is not a new art the artist is contriving but a new use of an art which before had many uses. The artist's problem is to use the formal disciplines which have accomplished the miracle of sensuous translation in other times and with other materials, to accomplish a new miracle of sensuous translation. He brings forward as his tools and implements the inherited devices of his art. And his labor, in a time of profound and unexampled change, is the difficult and arduous labor of compelling the inherited forms of his art to adapt themselves to the necessities of an experience for which they were not devised.

All writers in all countries in which the art of writing con-

tinues to be practiced in the years which follow the war will be committed to this labor in one form or another and all will find it difficult. But if it is at all possible in a matter such as this to judge the future by the past—and there is, so far as I know, no other means by which to judge the future—then it is possible, I think, to say that the writers of the Americas will find the difficulties somewhat less than will the writers of other countries. And for this reason: that the history of American letters is precisely the history of a long and difficult apprenticeship in the adaptation of an inherited art of letters to an experience for which that inherited art of letters was in no way devised; an apprenticeship in the adaptation of an art of letters developed in Europe to the experience of life in a country geographically, meteorologically, socially, psychologically, and otherwise unlike the country and the life of Europe.

This, I am well aware, is not the usual description of the literatures of the Americas. The general view, taught in the schools and treated in the scholarly texts, is the view that the literatures of the Americas, certain exceptions duly noted, are principally interesting for two reasons: first, that they are inferior to the European literatures from which they derived; and, second, that their inferiority is to be attributed to the fact that they are colonial. The problem, as the historians have generally seen it, has been the colonial problem: not the problem of the New World. It has been, that is to say, the problem seen from the point of view of Europe and the European tradition: not the problem seen from the point of view of the Americas and the American experience. The weakness of American writers, if you are to believe the books written about them, has been their tendency to the imitation of European writers; and their final enfranchisement will be—or has been—their creation of an American tradition of their own equal in merit to the European tradition from which they derive.

To think at all realistically about the future of American writing or about the work of American writers in the foreseeable future of our world, it is necessary, I think, to re-examine the colonial theory of American art and letters and to inquire how far this theory does really explain what it purports to explain and how far it leaves out of consideration what no theory dealing with these matters can leave out of consideration. How far, that is to say, are the inadequacies of literature in the Americas explained by explaining merely that literature in the Americas has been colonial? And to what extent is it necessary to have recourse to other theories and explanations to account for the many generations of failure and for the moments of miraculous success?

The colonial theory as I understand it goes something like this: The people of an old world—say of Europe—have developed certain arts, as for example the arts of cooking and house-building and hide-tanning and the representation of persons and scenes in colored oils upon canvas and the composition of accounts and descriptions in words and the performance of music upon various instruments. These arts and skills are passed along in the usual manner from one generation to another with a minimum of fuss and a variety of consequences but with little or no loss by the way. The new generation learns what it can from the old, does what it must do and what it can do with the means at its disposal, and passes the inheritance on down to those who come after.

This process goes on, interrupted by wars, varied by individual talents, but more or less simply and naturally over long periods of time until, sooner or later, a new land—a new continent or new islands or whatever—is discovered overseas and a migration to those newly discovered countries follows. At which point and without warning, everything is changed. The emigrants—part of the living generation of the old country

and co-inheritors therefore of its various skills and arts—carry their part of the inheritance out to the new land. They practice there the arts of cooking and housebuilding, of hide-tanning and oil painting, of stone masonry and music, of the manufacture of textiles and the manufacture of books, which their brothers and their cousins and their contemporaries continue to practice at home.

But the results of their practice are now not at all what they would have been had they remained in the country from which they came. Certain of their arts and skills become more artful, more skillful than they were at home. The emigrants come in time to build better drains. They slaughter better beef. They produce better crops. They manufacture more and better bathtubs. They produce better dentists, better doctors, better engineers, better athletes. But other arts, other skills, deteriorate. And the arts and skills which deteriorate most are always the fine arts, the pure skills—painting, music, and, above all, poetry and letters.

Why poetry and letters should deteriorate among a colonial people while other inherited arts and skills do not deteriorate the historians of these matters fail to explain. At least they fail to explain to those most interested in the problem—the writers and artists of the countries called colonial and so disposed of. American writers wish to learn, not that their work is difficult, for they know very well that it is difficult, and not that many American writers in the past have failed, for that too is obvious enough, but rather why their difficulties have been so great and why the history of their art in these countries is strewn with so rich and tragical a wreckage. To that sincere and long-asked question the word “colonial” gives back ambiguous answers.

There is, for one example, the common answer, known to every schoolboy, that the new countries—the colonies—because they are geographically new are also culturally new:—because

they lack a geographic past, lack also a literary past, and must wait for a past to be accumulated before they can produce a literature of their own. Another is the answer that new countries (i.e., colonies) provide no audiences for the arts and therefore can produce no arts. Still another is the explanation that the emigrants who go to new countries are not men of the kind who produce poems or music or paintings and therefore poems and music and paintings must wait for a different kind of man to develop. All of these are accepted as gospel truth by most of those who talk about the literature of the Americas. And none of them, I suspect, is even superficially true. I suspect, indeed, that it would be difficult to think of many generally accepted notions which are more completely false.

Take first the thesis that the new American countries failed to produce a great literature throughout their early history because they were settled by men of adventurous, hardy, and active types who were incapable of art themselves and incapable of breeding art in their descendants. The thought apparently is that artists and particularly writers are bred by other writers—or at the very least by sedentary persons such as professors, parsons, dilettantes, and stockbrokers. Nothing could be farther from the fact. The fact is that writers descended from other writers, as Mrs. Woolf was from Thackeray, are the exceptions. Writers rarely breed good writers and professors almost never. Writers, painters, and musicians are capable of turning up in the most unlikely families—and usually do.

Furthermore, it is pure romance to assert that the Americas were peopled principally by soldiers and bold adventurous people without nerves, minds, or the capacity of observation. New countries attract all sorts and kinds, including many of the principal producers of literary materials; and the Americas were not exceptions. Soldiers there were, but there were also convicts, parsons, disappointed revolutionists, politicians out of

favor, younger sons, illegitimate children, persons luckless in love, merchants with a nose for bargains, speculators, fanatics, people who valued liberty, people who respected their own convictions, and a thousand more beside—all the sorts, kinds, and species which produce between them artists, poets, and musicians in any country and at any time.

And as for the soldiers and adventurers themselves—some of the best writing ever done has come precisely from such people. I cite you for one Bernal Diaz del Castillo; for another, Caesar.

The same thing is true of the second explanation, which explains that newly settled countries are countries without background, without culture, without tradition, and therefore without the possibility of art and letters: the explanation which says: "But America is a new country: it must wait for time to ripen it." The explanation which says: "There is no American culture—yet." As geographical units, the American countries are "new" perhaps—though by no means as new as the European critics imagine. But as societies considered in terms of background, of inherited culture, they are no more new than are the countries of Europe from which their people came. For their people brought with them to America the same tradition and the same culture as they left behind them.

The settlers were quite as much the inheritors of the culture and the tradition of the mother countries as were the brothers and the first cousins and the first cousins once removed and the schoolfellows and the contemporaries they left behind them. If anything, they were inheritors and heirs more conscious and more zealous than the rest who stayed at home; for the inheritance had to them the added value of all things carried overseas and displayed like a chest of drawers or a box of family silver or a portrait of an ancestor or a leather-bound book in a Boston parlor or a drawing room in Salta or a hacienda in the Vale of Chile or a sod house on the Dakota plains.

It is a matter of common knowledge to all who have traveled in this world that there are no inheritors of tradition or heirs of culture more devoted or more passionate or more opinionated than those who have taken their household goods and their possessions and their memories to the provinces of a new land. Indeed it is precisely this that the word "provincial" in its pejorative sense implies. The taste of Boston or of Buenos Aires or of Rio de Janeiro was provincial in the last century because it admired too slavishly and protected too sedulously and possessed too entirely the arts and culture of Britain or of Portugal or of Spain.

The truth is that the people of the newly settled countries possessed the great stream of the inherited tradition down not only to the time of separation but well beyond—and possessed it with a fervor unknown to those who stayed behind. They were snobs of the tradition to a degree far beyond the snobbishness of the mother countries. One has only to consider the unquestioning and pious enthusiasm with which the women of the United States accepted British novelists and British poets, regardless of merit, throughout the nineteenth century and into this.

But if it was not tradition which was lacking in the new countries or human stock capable of producing writers and artists, neither was it a potential audience. The theory which explains American literary history in terms of the colonial audience is the familiar theory that the people of a newly discovered country are so busy building houses and hewing forests and running surveyor's lines and shooting Indians that they have no time to serve as ears for music or as eyes for poems. It is a plausible theory, but it has no basis in fact. It is true undoubtedly that the first years of the first settlements in the American countries were laborious and uneasy years. No one in the early years of San Francisco or Plymouth or Deerfield or James-

town or Vera Cruz or Lima or Rio de Janeiro had much leisure for book-reading—to say nothing of tables, chairs, and candle-fat to read by. But in the settlements which endured, this period was always brief—a generation at the most or barely two.

Far from having little time or little need for books, the people of these settlements required books and had time to read them as their descendants never would again. It was in the new settlement, and along the frontier as settlement moved westward, that men had time to read the great books through from end to end and not once alone but many times—Shakespeare, Camoens, Cervantes, and the Bible. And it was not only in the frontier that men in the United States had time and appetite for reading. Jefferson's library, the purchase of which was the true founding of the Library of Congress, was not the only great library in Virginia; nor was Virginia the only state of the United States to possess magnificent collections of great works. Neither in the United States nor elsewhere in the Americas was there any lack of men with appetites for books and means to possess them.

The truth, in other words, is that the theory of American letters which explains the inadequacies of American literature over many generations, and even centuries, on the ground that the American countries were colonial countries is considerably less than adequate. For one thing it does not explain what it purports to explain. For another it is mischievous. The young American writer who thinks of American letters as the critics have taught him to think of American letters, begins very shortly to think of his own work in the same terms: begins, that is, to tell himself that his task is to produce, not a poem or a novel or a play, but "literature"—"literature" equal if possible to the literature of Europe but in any case "literature."

A very considerable part of the self-consciousness which afflicted American writing a generation ago, and even less, was

the direct and natural consequence of this attitude. The preoccupation with "literature," the preoccupation with The Tradition which was so familiar a decade or so ago was an American contribution to the art of letters and could have been nothing else. Only Americans bred in the colonial theory of American letters could have thought of the art of writing as the art of adding to the tradition of English literature. To less self-conscious men the purpose of the art of writing is writing; and the tradition is a means which one employs if one can—a means which becomes an end only when the work is finished and the tradition accepts it or rejects it as history determines.

But the chief indictment of the colonial theory of American letters is graver than this. The chief indictment of the colonial theory is that it leaves out of account the true reason, the honorable reason, for the many and repeated failures of the art of letters in these countries, and neglects therefore the considerations upon which a true understanding of the American literatures or of their future may be based. The colonial theory is the theory of a new literature as it appears to those who continue to occupy, either physically or psychologically, the countries from which the colonists went out. But the problem with which the serious writers of the Americas have wrestled for centuries is not the problem of the emulation of Old World writers, nor the self-conscious attempt to escape from emulation into a new American tradition.

The problem with which the writers of the Americas have struggled has been the problem of the New World: the problem of a new literature as it looks to those who have brought the older culture with them to conditions and surroundings in which the forms of the older culture are foreign, inappropriate, and strange. The colonial problem is a problem imposed by emigration from a known country; the problem of the New World is a problem imposed by the occupation of a new. To

European critics it is important only that the ancestors of American writers went *from* Spain or Portugal or England or the continent of Europe. To American writers it is infinitely more important that their ancestors—or they themselves—came *to* America.

The difference is real. But it is not merely geographical. It involves also a difference—an ancient and frequently embittered difference—between the poet's concept of the art of letters and the critic's: between the concept which sees the art of letters as the art of creating *this* poem, *this* novel, *this* play, and the concept which sees it as a great number of poems, plays, and novels already written and now to be arranged together in a certain order, or a certain organism, called the literature or the tradition of the tongue. To the critic, feeling backward down his coral reef from the surface-present to the deep and crumbling rubble far below, the labor of the creation of a single coral cell or branch of cells has small importance. To the poet it has the supreme importance of an act unique and single in the world. To the critic the art of letters is literature and literature is in the past—an old existing country which needs but roads and road maps to be known. To the poet the art of letters is an art, and art is in the present—a process frequently repeated and never finally performed: the process of reducing to a form at once sensuous and intelligible the fragmentary, reluctant, and inarticulate experience of men upon this earth—the process, that is to say, the one known process, by which men present to themselves an image of their lives and so possess them. The art of letters to the poet is the mirror of time—the only mirror men have ever found of time.

The problem of the New World, then, is a poet's problem not a critic's. It is the problem faced by those to whom the practice of the art of letters is the practice of the art by which experience is reduced to form—and who practice that art in a

world in which the experience of men is new and unaccustomed—and the forms are old. It is, in other words, *the* poet's problem carried to the farthest point of difficulty. The labor of the poet is difficult in any country and at any time. But in a new country—in a continent in which the experience of men alters but the forms of art are old—it is a labor of which the difficulty is almost immeasurable. The raw material, the stubborn facts, of an experience never before resolved into art must be resolved: the raw material of geography, climate, the nervous reactions of men, their tricks and gestures, what they do here that they have not done elsewhere and what they do not do, how they get on with the new sun and the new rain and the animals, how they are with each other and how not, how they sleep and what images come to their sleep. But this is not the whole difficulty. It is not even the principal difficulty. The principal difficulty is that this experience must be communicated in forms of art never intended for its communication—forms of art unrelated to the experience on which they move.

In an old country, an ancient civilization like that of China in its great period, or a less ancient but none the less habitual civilization like that of England in the seventeenth century—a society which continues from generation to generation in surroundings more or less unchanged—in such a country the relation between the forms of art and the pattern of experience is easy and familiar: so easy and so familiar that the two are tangled into one and cannot be untangled. The references are immediate and immediately understood, the allusions are a second speech and equally intelligible, the responses of emotion are as natural and certain as echoes from an old-built wall.

But in a new country, and above all in a new country in which everything is different—seasons, geography and men—there is no such familiar and habitual relation between art and lives. There is on the contrary a lack of relation which is more

than a mere absence of that quality: which becomes instead a positive obstacle, an intrusive discord. The inherited forms of art carried to the new country by settlers and there employed are not only not forms developed in the new country for the communication of its experience, but, instead, forms developed in a different country for the communication of a different experience. They are therefore and necessarily forms which carry with them the tone, the color, the remembrance of the old experience. The principal reason why the labor of the poet in a new country is difficult is that this tone, this color, bred into the forms of his art, twisted into the sounds and meanings of his words, impossible therefore to avoid or evade, falsifies and discolors and distorts the image of the world he lives in: out of which he writes.

It is this fact, a fact well known to every sensitive writer of this hemisphere whether he writes in English or in Spanish or in Portuguese, which defines the true American problem in the art of letters. To represent by the use of a medium which carries in the fiber of its structure reflections and refractions of an altogether different experience—to represent by such a medium the experience of a new and altered world—is the labor to which the writers of the Americas have been committed from the beginning of their history. It, and not the colonial problem, not the problem defined by European critics, not the problem described by American writers in violent revolt against their work, their fellow workers, and themselves, is the problem common to us all.

The entire history of letters in this continent demonstrates that fact. Early writers in all our countries have been blamed by later critics because they wrote of America as though it lay in the valley of the Tagus or the yellow hills of Navarre or the sheep pastures of Devon. Nature, the critics complained, came to Anne Bradstreet, the seventeenth-century New England poet-

ess, not directly but "as something which had to be translated into the regular rhythm and rhetorical exaggerations of the English school of the time." But it was not Anne Bradstreet or her contemporaries of the other Americas who were at fault. Nor are later writers chargeable with moral turpitude and artistic dishonesty because they continued for two hundred years and still sometimes continue to write of American life in books and poems which could have been written equally well by Europeans who had never crossed the Atlantic.

The literary suicides of the Americas—the many Americans who destroyed themselves as American writers by one means or another—testify not to the indifference of the writers of these countries but to the difficulty of their task. These suicides—for suicides they are—are commonplaces in our literary history both north and south. Some men of talent, unable to compel the art to serve their purposes, resigned the effort altogether. Some, although they continued to write, gave up the attempt to write as men living in their own time and in the Americas, and wrote instead and deliberately as though they had lived a hundred years before and in a different country. Others again emigrated physically, as these last emigrated psychologically, returning from the New World to the Old and settling again in the surroundings and the society to which the forms they had inherited belonged. Still others escaped in an opposite direction, emigrating not from the new experience but from the tradition of the art, destroying themselves in anarchy and ignorance. Even the best, the most courageous and most skillful, were incapable over many generations of mastering the American experience *and* communicating it in forms derived from the traditions of the art.

It was not until Mark Twain that writers of the United States forced their art to serve them as Americans, and it was not until the present generation—the generation of Heming-

way and Dos Passos and Faulkner—that an American novel was written which could at once move easily in the great tradition of English letters and at the same time occupy and master the American experience of living men. The same thing is true of the poetry of the United States. Although Whittier wrote out of New England, and although Whitman broke hugely and violently through the English tradition of the art of poetry, it was not until the present generation of men now writing that a poetry native both to the tradition and to the country appeared in the United States. It was not until Eliot and Pound that the current of poetic influence was turned back eastward across the Atlantic.

It would be untrue and unwise beside to say, in conclusion of this matter, that American writers have solved for themselves the problem with which they have struggled for so long. Latin-American poetry is as fine as any poetry now written and the novel in the United States has surpassed the British novel with which it was so long and so unfavorably compared, but it would be presumptuous notwithstanding to pretend that the American experience and the old inherited forms of the art of letters have now at last been matched. Nevertheless, if it is true, as I believe it to be true, that the labor of letters in our own time and in the time beyond us is the labor imposed upon us by a new and undiscovered world, then the work done and the failures suffered in these continents will have their use. For in that labor the writers of the four Americas have served a long apprenticeship and gained some knowledge.

There are those I know who doubt that writers have played or can play an effective part in the histories of their peoples. There are, among others, the contemporary determinists who inform us that the proper role of the writer is merely to give words to a popular will which would have existed in any case without him—a will driven by economic and historic forces

beyond the power of any man to direct or control. But, though the opinion is very broadly held, I doubt that it has reason. I doubt that fatalism is a truer formula since Marx than it was before, or that it is any more admirable to surrender the will of men to the will of fate under a scientific name than under a mythological. But whether it is true or not that writers should be the followers of human destiny rather than the instigators of human purpose, one thing is clear and certain:—that no purposed human action is conceivable without an image of the world which is coherent and distinguishable, and that the creation of such an image of the world, recognizable to the emotions as well as to the mind, is the work of which the artist moving in the forms and words of art is capable.

Without such an image of the world and of their lives, men inevitably fall into such a surrender of the will, such a mute reliance upon mechanistic forces, as our time, and the generation particularly to which I belong, has made. It is because the world of our time seems to most of those who live in it to have lost its coherence and its meaning that the economic fatalities of the Communists, and the wave-like and inevitable futures of the Fascists, have had such power in men's minds. In a shadowy and chaotic world where nothing has reality and all the enemies are shadows, surrender to the mechanistic fates, the predetermined futures, becomes the only sure escape for frightened men. Those of us, therefore, who do not love the mechanistic fates or the predetermined futures will continue to believe that the writers of our own time and of the time beyond us must undertake to reduce to sunlight and recognition the shadowy chaos of our world, providing us, in place of the unopposable and terrifying shadows, an understandable experience of life with which the will of men can deal. For it is only by seeing their experience of the world for what it is—however terrible—that men can act upon it.

I have no wish to prophesy and no authority to read the future. But it seems to me possible notwithstanding that the writers of the four Americas—writers to whom the problem of the New World is a known and a familiar problem—may perhaps undertake this labor more willingly, and accomplish it with greater courage, than other writers will in other countries. It seems to me conceivable, in other words, that the long apprenticeship of the Americans, the centuries of labor and the fierce defeats, may perhaps end now in such a literature—so strong, so boldly knowing, so perfect to its time—that others who come after us will say the labor was the prologue to a noble art, and all the pain worth bearing.

The University in the Changing Society of the Future

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IN DISCUSSING the university and the future, it becomes necessary to say something about what the future of society will be. For the university does not exist in a vacuum; it is part of the social system and is subject to the social forces of the time. If the world is much at war during the next half-century, university life will be quite different.

But who can say what society in the future will be? Few are so bold; yet we must look ahead. Some things can be foreseen with a high degree of probability. For instance, it is certain that during the next fifty years we shall be speaking English and not German in the United States. In other cases the veil shuts out tomorrow. It cannot be said when the present war between England and Germany will end.

We are not able to draw for the future a blueprint of the whole of civilization. We can, though, single out a few probable trends which will be significant for the university.

Three of these major trends will be mentioned. The first is the great wave sweeping us on toward a powerful total state. The second is the bewildering rapidity of social change. And, thirdly, there are the marvelous new communication inventions which will stagger us with their impact. Let us consider these three factors in our future culture more fully.

First, it should be stated that prediction must be independent

of our wishes. I may be much opposed to the coming of the great state, but I should not let that influence my prediction. Next, it should be noted that a trend in human affairs is never as inevitable as a movement of shadows in the solar system. Humans can do nothing to prevent an eclipse of the moon. They can do something to prevent the totalitarian state. I may venture the impression, however, that mankind is somewhat overconfident in its ability to stop or alter to any great extent social trends.

As to the growth of the state—and I do not mean in a territorial sense—the process has been going on for hundreds of years. The movement is worldwide. In the United States the federal government has been expanding under both Republicans and Democrats but, parenthetically, a great deal more under the followers of Thomas Jefferson than under the adherents to Alexander Hamilton.

The reason why the state has been growing is due to the forces that have led to the decline of three institutions, family, church, and village. In the Middle Ages and earlier these three institutions were the main regulators of mankind and provided satisfaction to most of their wants. But there were growing two other institutions that have become huge by the middle of the twentieth century. These are the state and industry. Governments and economic organizations are increasing in power in modern times, while family, religion, and community retain but a fraction of their former influences.

The inventions using steam took industry from under the rule of the family; and the family lost influence accordingly. As industries expanded outside the home, they lacked the supervision which the family once gave them. Some needed close control, as, for example, public utilities and all industry needed some regulation, as in the employment of children and the safeguarding of dangerous machinery. So the state began to regu-

late industry as the family had once done; and in doing so governments have been growing and becoming powerful.

Additional family functions other than those of economic production are being transferred in part from the family to the state, such as the care of the old, the education of the young, the protection of the members of the family, and the treatment of juvenile offenders. Church and local community have, like the family, also had functions transferred to the state and to industry. So it is that the state has been increasing its functions and growing in power.

This process has not yet run its course. Furthermore, it is greatly accelerated by war. Modern wars are a collective effort of magnitude involving the training of a large number of fighters, the providing of munitions, and the bending of industry of all kinds to this purpose. To do these things the state, whether it be democratic or autocratic, must extend its functions through many new boards, commissions, bureaus, and authorities. In such times production calls for the regulation of prices, control over trade, continuity of labor, and the sure flow of the raw materials and semi-finished goods to every industry making war goods. The United States is not at war, but it is preparing for military defense; and the effect of preparation for war on the state is much like that of war itself. A war, therefore, speeds up the growth of the state.

In the democracies it is assumed that at the conclusion of the peace the war-time functions will be liquidated. Such was the case in the United States in 1919. Historical precedent points to such a return to normalcy and, accordingly, a reduction in the size of the state; in which case the future state will resume its slow evolutionary growth.

But the complete abandonment of the war structure of the state when peace comes may not occur. The reduction of war organizations will depend upon the type of peace. The signing

of a peace will be welcomed with a great show of joy and an outward attitude indicating belief that permanent peace has now come. But will the peace be long-lived? If England wins, will not the Germans, under another Hitler, try to rise again? If Germany wins, will not France and England get out from under as soon as they can? Can they do so without war? If neither side wins, is the peace merely an armistice? The prospect is clearly for more wars in the future, though a miracle may happen.

To this fact there must be added one other, that it takes a long time to prepare for a modern war—from five to ten years or longer. It has already been said that preparation for war, if it is well done, is not greatly different from war itself so far as the growth of the state is concerned. So, for the five or ten years of preparation for war an aggrandized state is needed. If, therefore, following the peace, preparation for new wars is undertaken, then we shall have a continuation of the great state.

A war is not the only crisis that needs enlarged powers of the executive. The severe depressions which follow in the wake of wars are enemies of the nation, too, and require concerted effort to meet them. Some of the organizations of government that are useful in the preparation for war may be of use in preparing for peace. The state itself was invented in war time in the far distant past, and was held over during peace time, particularly as an agency valuable in collecting tribute and holding peoples in subjection. So some of the war boards of today may prove of value after the war is over for the pursuits of peace time.

On the other hand, two great forces will work to demobilize the war structure. One is the desire to escape the taxes that are required to maintain an enlarged state. The other force is the desire for freedom. The war state restricts liberty of action. Hence, we shall want to unshackle ourselves from the restraints of the war organizations. Two powerful forces—the desire to be free and the desire to escape heavy taxes.

Taking into consideration all these factors, I think there is great probability that the state will have much more expanded functions after the present warfare has ceased than it would have had, had there been no war. Just how great the state will be it is difficult to say; but it is concluded then that the prospect for much greater states in the near future is sufficiently strong to take into consideration in any plans that may be made regarding the university.

We come, then, to the second of the three major social trends of the future, that is, more rapid changes. It is customary to say that we live in an age of change, implying that we have just left a stationary condition and that the era of change will be succeeded by a plateau of relative calm and quiet. Neither the facts of history, nor analysis, support this conception, though there is unevenness in rate of change.

Changes are caused by inventions. The steam engine brought factories, cities, and other social changes too numerous to count. With the gasoline engine came metropolitan areas, mechanized agriculture, bankrupt railroads, consolidated schools, increased crime, more accidents, new types of vocations, and changed manners and morals. Society in the first half of the twentieth century is different because of telephone, radio, motion picture, and automobile. It will be different in the latter half of the century because of television, telegraphone, facsimile transmission, photoelectric cell, alloys, fluorescent lighting, air conditioning, refrigeration, airplane, helicopter, contraceptives, plastics, chemical fabrics, fabricated foods, synthetic hormones, and farm machinery. With these revolutionary inventions will come changes in other institutions than the state. Cities and farms will be profoundly modified. Church and family will be further altered. New businesses will arise and old ones disappear. International relations will not escape these changes. We shall live in an environment of rapid social change.

Finally, a third great trend of the future is the dramatic

extension of communication. Any new innovation that quickly spreads ideas is significant for society and for the university. When one person may address an audience of a hundred million listeners, the possibilities are tremendous for education and for propaganda, for speeding up movements for progress and movements for destruction.

But why should a speaker address multitudes measured in millions? Sometimes to inform them, but more often to persuade them. Hence, the great rise of advertising and of propaganda. The word propaganda came into wide use at the time of the first World War, before radio broadcasts existed. The idea of the war-time propaganda was to make us patriotic, optimistic, to lead us to believe the Germans were Huns who committed atrocities, and to encourage us to fight for democracy.

The Chinese word for propaganda, I am told, is "thought-control." It is well to reflect on that interpretation which the realistic Chinese have given it. Many of us operate under the illusion that we do our own thinking, originate our own ideas. In reality, the social environment supplies us with our ideas, which undergo, of course, some alteration from individual to individual. A white child, though, reared among the Indians has the ideas of the Indians.

Propaganda not only supplies us ideas and controls our thoughts, but it also manipulates our emotions. Thus the emotions of the German people were played upon by the Nazis after they came into power. German aggression was first oriented toward the east, particularly toward the Ukraine. So for four or five years the German propaganda minister had built a mighty hate against Russia. When national policy was about to envision a battle front in the west and, of necessity, a peaceful eastern frontier, Goebbels was asked, "What about all this animosity you have built up against Russia?" The answer is reported to have been: "Double my appropriation and in six

months I can have the people loving the Russians." Are we so much putty in the hands of the propagandist? Can we be made to think anything that someone wants us to think? There are, of course, limits to propaganda and we may listen *ad nauseam* to the glories of a toothpaste without ever spreading any of it on a toothbrush. But none will deny that our minds are open to attack by propagandists.

The weapons in the hands of propagandists will not only be the radio, printing press, and motion picture, but there will be newspapers made in the home transmitted by wireless. Television will make the eyes as well as the ears an inlet for propaganda. The airplane will distribute printed matter more quickly to the remoter populations. Messages over the telephone will be recorded in cases when there is no one to receive them. Cheaper and quicker printing will be available. Faster automobiles and highways, helicopters and stratosphere flying will knit a large people closer together so that the volume of their ideational and emotional response will be greatly magnified.

These new communication inventions, though, may be used for education and for imparting correct information as well as for persuasion, for distorting facts, and for arousing the emotions. In any case their potentialities for good or for bad are very great. They will step up the tempo of change, modify the size of governmental units, increase centralization, break down isolation, and will give a characterization to the twentieth century, as steam and steel characterized the nineteenth century.

We thus conclude that these conditions of the future, a great state, rapid change, and communication inventions, will not be without effect on the university. In relating these to the university the conception of only one aspect of a university will be discussed. This conception concerns the relation of the university to the community. A university is a part of society and like everything else subject to the environmental forces. But

the university is also set somewhat apart from the community. The professors of a university are not engaged in buying and selling, in producing commodities or in transportation. They are somewhat removed from market place and factory. This detachment is not so extreme that the teachers dwell in ivory towers. They do live, though, in libraries and laboratories. The thoughts of a historian may be with the ancients, and the geneticist spends long hours with his bottles of experimental fruit flies. Such activities are interpreted by the critic as aloofness and are deplored. On the other hand, these activities mean a situation favorable for farsightedness not found in the daily activities of economic man.

That the university is of course not wholly aloof from society is so well known that it hardly needs to be mentioned. A major policy of universities has been one of service to the community here and now. This policy has been emphasized in donations and by grants from legislatures. By inventing hybrid corn universities have increased the yield per acre by fifteen or twenty per cent. They have discovered a way of putting vitamin D in food which makes children healthier. The lives of thousands of diabetics have been saved by insulin, a university product. Such services to the immediate and permanent needs of humanity are admired by all. No one questions the value of such a function. It is the obviousness of this usefulness that makes it desirable to stress the services which come from a more detached, long-range activity.

Such, then, is a conception of the university which will be examined in view of the probable growth of the state, the almost certain rapid changes ahead, and of the expected impact of the communication inventions.

The rapidity of change which will characterize the future indicates the necessity for some institution in society that has a long-range perspective. Changes are turbulent and uncertain.

In such times man needs a rock-of-ages to which to turn for safety. We want the comfort and assurance of a great authority to guide us. Throughout the ages, mankind has again and again shown this desire for certainty to be one of its profoundest needs. He who does not recognize this has not much understanding of humanity.

The church has been the great answer to this yearning. To a much lesser degree other institutions have met the need. The Supreme Court of the United States is to the people in our country a symbol of a guiding authority in matters of law. These men with long black robes, in their marble temple, are believed to be above the pettiness of politics and beyond the prejudices which characterize the activities of ordinary men. The Court is not to be tampered with by packing schemes. Whether or not the university is to be such a symbol for humanity amidst the revolutionary changes to come, it has capacities which enable it to occupy such a position in society.

These capacities flow from the intellectual setting of a university. Indeed, history shows the enduring nature of these intellectual centers. The universities of Europe have survived while empires rose and fell, though their lands were transferred from one state to another. They have seen the Feudal System collapse and the Industrial Revolution begin. History makes them a symbol of something that endures.

The rapidly changing future presents a problem as well as an opportunity for the universities—a problem of adaptation. The university is, however, not an institution that adapts readily; not as easily, for instance, as a business which has to make a profit or go out of existence. The long tenure of the faculty, desirable as it may be, is an obstacle, though possibly a minor one, to such adjustment. Perhaps, in the future, faculties may be more sensitive to their obligation to change.

Another aspect of the university's relation to change is its

long-range view. This perspective has usually been directed toward the past by social scientists, natural scientists, and scholars in general. Indeed, tradition is a powerful force in the life of any university. While a connection with the past has its virtues in a changing society, it also presents resistances to desirable changes. In fact, in a world where the future will be different from the past it is difficult to see how any group whose look is backward can be helpful. If the university could bring itself to look forward, difficult though it be, its value in a changing world would be much greater. To whom else could a society turn for vision in trying to see the shape of things to come? Planning boards will be set up to focus this function, but they in turn may well depend upon the universities for aid.

Social change, itself, in the future means a greater desire on the part of an uncertain humanity for an institution of authoritative guidance and will create for the university a problem of adaptation and the need for a vision turned away from the past toward the future.

Turning next to the impact of the communication inventions upon society, may we recur again to the idea of the relation of the university to society? The relation of anyone to society is essentially a relationship to the present. This fact is seen when it is recalled that an individual acts in response to stimuli and that one's personality is the result of such responses to stimuli rather than to a predetermining heredity. These stimuli are always around us. Hence we are creatures of the present. The contemporary is ever with us. It is for this reason that Jesus went up into the mountain to pray. Our view most of the time is bounded by the limits of the contemporary.

Let us add to this idea of stimuli the idea of moods. Moods derive in large part from the subjective, though they are attached also to outside stimuli. Hence, what we see is thus colored by our moods. They thus affect our vision as do con-

temporary stimuli. In fact, we cannot see beyond our moods. A mood somewhat magnified is that of the manic-depressive. When he is in manic phase he is optimistic. Life is a bed of roses. He can see no storms ahead. But when his depressive phase comes around, all is black despair. There is no hope. No cloud has a silver lining. He is blinded by his moods and it is truly remarkable how he cannot see beyond them.

Mankind in the average is manic-depressive, too, though, of course, much less so than psychotic individuals. In the prosperous 1920's we were in a manic phase and the force of contemporary stimuli was strengthened by moods. It was a new era. Prosperity was to be permanent. The business cycle was smoothed out. Economic depressions were conquered once and for all. How shortsighted we were! Came the depressions of the 1930's. The picture had changed. This was not a mere business cycle which meant that good times would follow the bad. Hard times were to be permanent and capitalism was about to suffer a complete collapse.

Let us now add to the idea of stimuli and to the idea of moods the idea of social pressure, and we shall get a better conception of how strong the contemporary really is. Social pressure, too, reinforces stimuli. When we live on Main Street in a small village, for instance, we not only respond to the stimuli around us but we are forced to conform to them whether we want to or not. Galileo experienced such a social pressure, as did the many martyrs of the past. In other words, the intensity of stimuli is multiplied by an actual force of social pressure. It is no wonder, then, that the contemporary so restricts our vision, under influences of the surrounding stimuli, of moods and of group pressure. In a changing world we need as never before to look beyond the present.

For instance, a university professor of economics may be opposed to holding companies and impressed with the great

danger to society in the policies of such a public utility company, even though it be one of the greatest financial empires that ever existed. When his opinion becomes known, the financial barons may call for the professor's dismissal, which, should it occur, would be a disgrace to the university. In a year the public utility empire may collapse, investors may lose many millions, and the financial czar may be in flight in foreign waters with a warrant for his arrest. A university should not have to bow to such irrational winds of the local.

The communication inventions have the effect of increasing the power of the present for the reason that they multiply the stimuli and increase the social pressure. With these inventions stimuli come in through the air, past stone walls. With facsimile transmission, television, and airplanes added to telephone, radio, printing presses, photography, and automobile, it will be difficult to escape the invasion of a multitude of stimuli. The wide use of these new inventions will have the effect of turning the whole nation into one big Main Street. The pressure of public opinion may be even more overwhelming at times than the pressure of gossip in the village.

The communication inventions can be used also to increase our perspective, and college and university may use them in their work. But it is probable that their chief use will be to increase the stimuli of the present, often, it is feared, to distort facts and arouse emotions by propaganda. We shall be greatly in need of our faculties for hard, critical thinking. May the university with its habits of intellectual criticism be a lighthouse toward which to turn! Techniques will need to be developed for resisting such propaganda. To retreat into a cloister is no way, of course, to meet the problem.

We conclude, then, that the increasing use of these new agencies of communication and contact in the future will affect the role of the universities. They reveal the need of a wis-

dom based on perspective and of an institutional vantage point such as the universities possess. The problem for the universities is not to succumb to the tyranny of the present nor yet to escape into a retreat.

Under the third great influence of the future, the growth of the state, how will the university fare? Government is interested in research as is the university. At present research done by the government tends to be intensely practical, having to do with forests and aviation rather than with smashing the atom and cosmic rays.

It is not likely that a collective state will do much to encourage "pure" research, that is, research in pure science, as contrasted to research in applied science. Of this, though, we cannot be certain. The more expanded the government's services the greater will be competition for the taxpayer's dollar. In this competition the chromosomes of the fruit fly will not fare as well as old-age pensioners. The great state in peace time, like the state in war, will be expensive to maintain. As a larger share of the social income is taken, there will be less for the private universities. The amount of endowment for universities, however, is quite a small part of the total income of a country and with an increasing portion allocated to the state there could also be increasing contributions from private sources to universities. Still, it would seem that the conditions favoring the growth of the state hardly encourage increased contributions for pure research.

If wars are ahead, then truly the outlook for university research is dark indeed. War in Europe has meant a suspension of much university research. Research in Germany since 1933, when preparation for war began in earnest, has been largely devoted to engineering types of research, such as found in the four-year plans dealing with the production of gasoline from coal, rubber, woolen fibers, and chemical foods.

The universities ought, therefore, to make public opinion aware of the value of detached research. For instance, U²³⁵ is a discovery of disinterested science. Its value some day as a source of power may be incalculably great. It is not probable that this activity of uranium would have been discovered in the intensely practical researches favored by governments.

There is another aspect of the coming collectivism that is highly significant for the university, especially for the social sciences. It is the growth of the spirit of nationalism. In war the spirit of nationalism is whipped up to an intense patriotism. If a war state should be maintained during peace time, nationalism may call for a devotion not unlike the loyalties of religion.

One of the problems is to maintain support, financial and otherwise, of the great state in peace time when cities are not being bombed. In such times it is necessary to resort to extreme measures to stimulate and encourage strong devotion and great loyalty. Hence, the spirit of nationalism will be cultivated, if it does not arise spontaneously. The great state will be big, powerful, far-reaching. Should the state manage economic production and consumption, it will become very powerful indeed. All human activities will be the concern of the total state. The state in an extreme form becomes omnipotent. During a war or in a period of preparation for war the government needs the support of a unified people. Hence a one-party system is demanded or a union of parties rises to power. Opposition tends to be crushed, one way or another.

In building up such a nationalism, the communication inventions play a most important part. Their influence on public opinion is tremendous. Indeed, it is not possible for the great state to avoid being an important molder of public opinion and becoming a great propaganda machine. In emergencies demanding both unity and speed of action, censorship, where there are dictators, is arbitrarily imposed, and oppositions are

ruthlessly crushed by physical agents of the government. If strong executives do not exercise these functions and if freedom of discussion is not restricted by law and the police, then the social pressures of democracy will do so. Fear, the fear of losing influence, of being ostracized, of being unpopular, of bad form, is often as effective a device of control as the police.

The all-powerful state, then, in a television age is likely to be accompanied by a mighty nationalism of a religious nature. How will the social sciences of a university function in such an atmosphere? Karl Marx cannot be criticized in a Russian university. The race question cannot be examined scientifically in any university in Germany. Italian universities cannot deal freely with population studies. A new struggle between religion and science thus arises—not between natural science and the orthodox religion, but between the social sciences and the religion of nationalism. It is quite likely that the universities may have to take some defeats in such a struggle.

Will the universities not also be able to influence this trend toward an intolerant nationalistic religion? Basic to the exercise of such an influence is the assurance to the universities of a reasonable degree of security against attacks from nationalism. Already nationalism in one form or another is influencing the writing of textbooks, demanding that they be patriotic and set forth only the advantages and not the disadvantages of our social system as well as our country. It would be difficult to get a hearing today on the faults and errors of democracy. Leaders of religion have been notably intolerant. Nationalism also may persecute.

The success of the social sciences in their forthcoming struggle with a nationalistic religion will depend in part on the strength of the scientific method in the social field. If it is proved scientifically that the earth is round, the opposite view held by religionists will have to give way. If it be proved that

a small population has a higher standard of living than a large population, views held to the contrary by nationalists will eventually yield. The social scientists, though, will need all the proof they can get.

Scientific conclusions are not the sole determinants of the policy-making function of the state. Choices rest on values as on facts. The social scientist may be able to give us the scientific answer on every issue concerning immigration, yet some persons would still be opposed to a policy of restriction, while others would favor it. The roles of the expert and of the policy-maker are different. The one deals with scientific conclusions; the other with choices resting on values; though the facts and conclusions of science aid in the choice of values and the scientist often chooses problems of research whose solutions would be of great value. The experts in the university are not likely to be as troublesome for the university in the coming struggle as those who are concerned with policy-making. The university, though, is not without its advantages as a contributor directly to the policy. The professor of economics is as useful in policy-making in regard to the tariff as the sugar manufacturer who selfishly favors a high tariff wall. The special interests of the sugar manufacturer, like those of the contemporary and of the local, are not very farsighted. The university, if given adequate support, should be a useful social institution in a society when the propaganda of nationalism turns on the heat. It is in such situations that we appreciate the meaning of freedom.

At this point, before closing, a qualification may be needed. The great state may not become as powerful as the possibilities here considered. Its omnipotence may occur only in the eventuality of an all-out war. It is very difficult to estimate degrees of change and hence the degree of power of the state. That the trends will be in the direction indicated seem inevitable, though to what particular extent it is difficult to say.

In conclusion, then, the place of the university in the pattern of the civilization of the future is seen as one where it shall be an institution of intelligent vision beyond the restricted limits of the contemporary view. The all-powerful state, the marvelous development of communication inventions, and the vast social change will challenge this position. It will be one not easy to maintain. But in proving their worth, the universities may be even more valuable to society in the future than they have been in the past.

Economics and History in the American University of the Future

EDWIN FRANCIS GAY



ALL THE social sciences are involved in this discussion, although I have chosen to speak chiefly of economics and history, the disciplines with which I am more familiar. As history has broadened its scope and economics has acquired new techniques, they have become highly self-critical. Despite their recognized shortcomings, they and their kindred sciences must assume a larger share of social responsibility. Already they are beginning to interpret the revolutionary forces, so rapidly and radically altering our economic, social, and political life. Their greatest task is to assist in directing these revolutionary forces into evolutionary channels.

Into the mighty conflict of ideas, faiths, and systems, as well as of arms, we are slowly but inevitably being drawn. This conflict strikes into the very core of our spiritual being as well as our existence as a nation and a free people. Is the gain thus far made in the long, hard struggle of the Christian ethic to be preserved and the world prepared for another upward march? Or must history record another of the deep, wide chasms out of which mankind must again clamber? Who can speak with any assurance concerning the character of postwar reconstruction?

Looking back, we realize that in essence the 1914-1918 war was fought for principles like those now at stake. It was a contest among empires for the hegemony of Europe and, what

meant most to us, for control of the oceans; in addition, it was a fight for government by law and democratic consent. Our idealism was appealed to on behalf of democracy and world peace; but we did not realize how much our own national interest and future welfare were concerned. When victory came we did not see what it had achieved or how to retain its gains. In the fateful "return to normalcy" we lost the peace.

Some of our historians then failed us; they made laboriously annotated studies of the European causes of the war, based mainly upon diplomatic documents, and came out with the original finding that after all a great deal was to be said on both sides. Another group, investigating the reasons for American participation, arrived at the extraordinarily superficial and erroneous conclusion that our simple-minded idealism had been led astray by war profiteers, international bankers, and British imperialists, utilizing a malign propaganda. These writers overlooked the most fundamental of the moving forces. Was it of no moment to the world that the peace of the oceans should be kept by a great free-trade power that, with all its faults, was on the side of justice and good-will among nations? Or would it have been better to hand over the military control of Europe and Great Britain's sea power to the nation whose recent history had shown it to be contemptuous of good faith and a believer in "blood and iron"?

After the war the United States, having become a great creditor nation, should, in its own interest and that of world rehabilitation, have scaled down the so-called war debts and at the same time eased the foreign payments due it by prudent lowering of its high tariff walls. Instead, it raised the wall still higher, thereby becoming one of the first countries to initiate the gradual strangulation of world trade that contributed to our present tragedy. Our thinking did not keep pace with our changing world position. Many of our economists, it is true,

recognized the needs of the situation. As individuals they signed a protest but took no effective stand as a group, and they were not listened to.

This reminds me of a Washington colleague who after the war became economic adviser to a large manufacturing firm. In the early summer of 1920 he made a tour to sound out the economic situation. On his return, at a meeting of the company's executives he reported with proper professional reservations the indications of a coming decline in business activity, and strongly recommended an immediate reduction of the firm's over-large inventory. He was bawled out by the sales manager, who declared that the volume of shipments was unprecedented. A few weeks later the slump came. Cancellations of orders poured in and the company in turn had to retrench at considerable loss. At a meeting called at this time, the president reminded his executive committee of the disregarded warning of the economic adviser. Turning to the economist, the sales manager said accusingly: "You simply gave your opinion; why didn't you pound the table?"

If economists were in substantial agreement that a higher tariff was fraught with serious danger, should not the profession have exerted itself by organized effort to influence public opinion? Can they plead in extenuation that they were so wrapped up in their professional controversies that they could not, in the public interest, define and emphasize the area of common consent? Or do they fear being accused of propaganda when they seek to disseminate their considered convictions?

For other social scientists during the postwar period have been analyzing and exposing "propaganda" methods until the public mind has become confused to the point of viewing all persuasion whatever, whether for truth or untruth, to be evil and therefore suspect—a debilitating attitude conducive to pa-

ralysis of judgment and action. This technical study of propaganda is a clear case, not at all unique in the social sciences, of overemphasizing specialized techniques, of concentrating upon means to the neglect of ends.

Again, the specialties such as legal, constitutional, political, or economic history call for separate investigation; but they cannot safely be severed from humanity's "seamless robe." Economics needs the sustenance it could imbibe from its sister sciences, notably from the recent advances in sociology, social anthropology, psychology, and psychiatry. Despite occasional recognition of the investigations of group, class, and mass psychology, the economist still in the main thinks in terms of a crude and obsolescent individualist psychology. His whole assumption of man as a rationally calculating mechanism unduly neglects the emotional urges or Paretoan "residues." They are not merely minor and amusing frailties of the human animal. I am saying nothing new in urging this close interplay of all social studies. I am simply "pounding the table" when I plead that in the university of the future the social sciences be given the opportunity for more expansion and interpenetration rather than less. The social scientist, to sum up, must continue to specialize and, as a specialist, take account of all the factors that impinge upon his problem. He must also be more than a specialist. He has social responsibilities as well as scientific, and neither science nor society will long tolerate half-truths.

Beside the internal perils of the social sciences, such as too narrow specialization, an external danger now threatens. The university of the future should further the social sciences; but there is reason to fear that social research may be more poverty-stricken than it has been. There can be no blinking the inevitability of extremely heavy financial burdens resting on the entire community, on the entire world, after this exhausting war is ended. Taxation will and should be up to the limit of

endurance not only during the struggle but beyond, though its effects should be studied along with its admitted need. The sacrifices this war and its aftermath will bring upon our people will be greater than most of us can visualize. And our universities will suffer, probably the privately endowed more than those supported by public money. Some assistance from new foundations may be forthcoming for a time from fortunes fleeing from the upper brackets of the income tax, but the great benefactions to education may well be fewer than in the last half-century. With smaller financial resources our colleges will scrutinize more closely each item in the budget. The day of steadily widening curricula may be over, but some way of giving more content to the courses that are left should be found. It does not require much imagination to foresee the mental workings of the harassed college administrator. Though a minimum of social science may be taught, research, always lauded in principle but stunted in fact, may not be effectually encouraged in comparison with that in the natural sciences, which is more tangibly and immediately fruitful. Indeed, such is the practical usefulness of natural science that industrial laboratories bid fair to surpass those of the university not only in the applied but even in the so-called "pure" aspects of science. Business' cultivation of research is of course to be welcomed, but the interests of the university should thereby be strengthened. The university of the future must so organize itself that it can both teach and explore. It must be surer of its contribution to the intricate problems of a changing world. Its research must be more intensive. If the coming age is to be more technological than the past, then its technicians will all the more need and demand an intensification of research in the social sciences. For in that coming age history and economics, in conjunction with the other sciences of man in society, will be enlisted by the leaders, both political and technical. They will be requested more

urgently than ever before to describe accurately, to analyze, and to help in guiding the evolving social organization.

The historians will make clear that during the last quarter of the nineteenth century those signs of change became visible, sporadically at first, then more systematically, that are now patent everywhere to all. This historical age has inherited two basic elements from the Industrial Revolution: its technology and its factory system. Technology has extended to untrodden fields and above all has added to its former conquest of steam the enormous power of electricity. The factory has grown from relatively small units run by capitalist owners, often in partnerships, to the modern, manager-run, large-scale units, owned by corporations. The changes in scale have had consequences both internal and external that are equivalent to changes in kind.

The first activities of free enterprise required and were conceded emancipation from governmental control; the succeeding development has demonstrated the necessity for the reimposition of such control. The state had transferred large segments of its authority to the entrepreneur class, while the mass of factory workers came under a discipline and regimentation hitherto unknown. The coexistence of an increasing degree of political democracy with an expanding industrial autocracy has given rise to tensions in our social system. The watchword of the first age was free competition under a price system that was supposed by its attendant theory to operate by means of a self-correcting mechanism, an automatic equilibrium, or a "predestined harmony." But as the economic organism progressed in size and complexity the facts have not accorded with the theory. The large-scale units, often in working agreement with one another, in ever more extensive realms of the economy, national and international, tend appreciably to govern rather than be governed by the market price, thereby impairing the self-correcting character of the price system. As the organiza-

tion of production, marketing, and the accompanying banking and transport systems grew larger, both capital and industrial population became concentrated; and as competition grew more ruthless, problems of urbanization and governmental regulation pressed upon the preceding generation. "Security" displaced "competition" as a slogan. Industrialists sought protection, externally by demanding high tariffs from the state, and internally by themselves organizing trusts, mergers, or cartels to check unbridled competition. The workers sought an analogous protection by coalescing in unions for collective bargaining and by obtaining from the state safeguards for factory conditions and finally for wages and union recognition. In other countries consumers built up their own mechanism of protection in co-operatives which, like the great unit enterprises of production and distribution, play a significant part in the price system. The pressure toward security by combination or appeal to state action has extended in various degrees to all the industrialized nations. Moreover, the rule of mighty, impersonal forces in the economic world has tended to depersonalize the individual; the natural consequence, the proliferation of fraternal and social organizations, seems not yet to have had a fully compensatory effect.

Out of these conditions has come a world-wide authoritarian movement. It is an organic outgrowth of the age of free competition. For the last sixty or seventy years it has been gathering headway. Like all great structural changes in social organization throughout history, its growth had its quiet, inconspicuous beginnings, its normal periods of adjustment. Not infrequently the peaceful evolution has been broken by the violent upheavals and dangerous aberrations that characterize the rise of the modern dictatorships. They answer the plea for security by complete centralization of authority, and the more extreme among them in the totalitarian regimes have taken a decep-

tively alluring short-cut—unified control enforced by violence and disregard of all the rights of the individual and of all moral sanctions, save only that of obedience to the state. At this moment in humanity's long march along the perilous track between chaos and despotism, certain nations, dragging others in chains behind them, are proclaiming as a "New Order" the oldest of all systems of government, that based primarily upon coercion and fear. Totalitarianism is in fact like a malignant disease. The social organism in its normal process of growth has become infected with a cancerous malady for which the one remedy is excision.

Yet when this evil invasion is eradicated, the problem of peaceful change remains. By wishful thinking we cannot escape the drive and drift of a century of world-wide evolution and turn back to the untrammelled individualism of the entrepreneurs' great period. The state is gradually resuming some of the authority it temporarily transferred to private hands during the Industrial Revolution; it must probably go still further along the same road if democracy without anarchy in an interlocked world is to be our social goal. The old absolute governments, which attempted to impose order on the individualism of the Renaissance and Reformation, broke down from sheer administrative incapacity to lead and master satisfactorily the rampant upsurging social forces. The situation today is vastly more complex and confusing, its problems complicated far beyond the bounds of any single country by international forces that strike literally "from China to Peru." It is true that our knowledge for establishing and maintaining the necessary controls is much greater than in the days of the mercantilist state; communications are speedier, education of all kinds is more diffused, and production with its potentialities for human welfare is vastly increased. It is true that in recent decades economists are beginning to analyze the central problem of

monopolistic competition, the disruptive rhythm of business cycles, testing the theories of monetary and price controls; economic historians are examining anew the extension of governmental regulation. Political scientists are writing on such topics as "The Role of Politics in Social Change"; sociologists are studying such phenomena as the new era's maladjustments in the spheres of personality formation and social organization; and statesmen have at last found that they must intervene to alleviate the shocks of business fluctuations.

All these are signs and portents of what lies ahead. There is hope that the social scientists of the university of the future, with vision focused on the necessities of the times, may help in the readjustments of our society through an informed recognition of the direction of the change. A spirit of blind fatalism will not be able to ride the "Wave of the Future"; we must see to it that through intelligence and courage we keep an even keel. Social scientists, in co-operation with leaders of industry, labor, and government, must by trial and error, compromise and adjustment, study and restudy, help to define and keep to our "way of life." That way is stable, not static. Stability means a continuous shifting of balance, continuous modification of conditions, and minds open to ends accepted by common consent, not imposed by force. Our age has new rigidities, national and international, to dissolve, clogs in organization and mental attitudes to dislodge or circumvent while upholding the best standards of our tradition of liberty. Sufficient room must be given the free play of personality, initiative, and industrial enterprise. It will not be simple or easy; but when the German menace with its war on liberty has been removed, we have in the English-speaking nations and among the like-minded elsewhere the resources of nature, of intellect, and of democratic good-will to attain the goals we set for ourselves.

Inasmuch as economics and history would be nothing with-

out the individual, I cannot do better than end with the words with which Louis J. Halle, Jr., ends his book on Mayan culture, *River of Ruins*:

Ultimately, it is the individual who creates a civilization, and it is the individual who must save a civilization if it is to be saved at all We, as individuals, are essentially no different from the men who created civilization. It is simply that we have lost touch with the reality of the outer world in which we live and of the inner life that gives us our distinction.

We may be sure that no technical adroitness, no mechanical makeshift, will save our disordered civilization from the ruin that overtook its predecessors. Only by rediscovering in ourselves as individuals the essential dignity of man shall we find the key to our salvation and once more establish our unique greatness in the world of nature.

Forum Radío Broadcast



FROM Memorial Hall on the campus of Stanford University, Palo Alto, California, we bring you a round-table discussion in connection with the symposium, "The University and the Future of America." This is the fourth and final day of the symposium in which a score of the nation's most distinguished scholars have participated at Stanford University. The symposium is a part of the University's commemoration of its first fifty years.

During the present week leading physicists, astronomers, physiologists, geographers, psychologists, sociologists, and other experts have endeavored to look into the future to ascertain what might be the shape of the new society. They have given special attention to the place of the university in the new scheme of things to come.

During the next thirty minutes four American scholars will review in a round-table discussion some of the factors that have been emphasized during the current week. These scholars are: Dr. Ray Lyman Wilbur, President of Stanford University, a leader in the field of medicine; Dr. Edwin P. Hubble, astronomer on the staff of the Carnegie Institution's famous Mount Wilson Observatory; Archibald MacLeish, poet and Librarian of Congress; and Dr. Roscoe Pound, legal scholar and University Professor in Harvard University. These gentlemen will now discuss "The University and the Future," with Dr. Wilbur as the chairman. Ladies and gentlemen, Dr. Ray Lyman Wilbur, President of Stanford University.

Dr. Wilbur: Dr. Hubble, since you are to be our astronomer and are going to cast our horoscope into the future along the

lines of our first address, I'd like to have you identify yourself by some pertinent remark.

Mr. Hubble: I look forward to the university of the future as being a smaller institution with even higher standards than we have today.

Dr. Wilbur: Dr. Pound, you're a versatile teacher. You've given the benefit of a lifetime telling young people where to head in. Now, what are you going to start off with on this subject?

Dean Pound: Well, I'm afraid I shall have to start off by taking a different view from Mr. Hubble. I look forward to universities which will be large enough at least to take care of the very serious problem of a politically organized society in which every individual, if he's not, as Huey Long said, "a king," at least has the responsibility of taking a large share in the government of his fellow men.

Dr. Wilbur: Now, Dr. Hubble, you'll have to wait for your turn, because Mr. MacLeish here is thinking of taking an airplane in order to find a new audience, and we're going to start off with him, giving him a chance to say what he has to say and back out before we can give the answers.

Mr. MacLeish: Dr. Wilbur, that's very kind, because on my right here is a man under whom I sat for three years in the Harvard Law School and for whom I still have a very wholesome respect in the Biblical sense of that term. [*Laughter*]

Dr. Wilbur: Well, I'll keep him quiet while you talk this time, so that you can go right ahead.

Mr. MacLeish: It seems to me that one question we have to resolve at the beginning is what we mean by "a university." I take it that by "a university" we mean a university as distinguished from a college, and my suggestion would be that by "a university" we think of an institution which has a certain responsibility for the preservation—the defense and preserva-

tion—of the inherited culture. Now you defend and preserve an inherited culture not only by defending it and preserving it against the people who want to “burn the books” but by keeping it alive. That is to say, a culture can die of inanition and over-proliferation of details as well as it can die in a bonfire. And the primary problem, I should suppose, that a university would have to consider from that point of view would be the problem of making available to the masses of the people of the democracy the inherited culture. The particular problem now, in terms of the future which we can foresee, is the problem of making available a culture which is becoming so infinite in its detail, so complicated, so subdivided that it is beyond the grasp of any but very highly educated people. From that point of view a university becomes a society of scholars who have a midwife function: whose function is to interpret between the body of knowledge, a very highly complicated body of knowledge, and the masses of the people, or at least that part of the masses of the people which is interested in and able to make use of knowledge in that form. Now, whether or not this is the central problem of the university of the future I don't know. I gather from remarks I heard in the not so far distant past that Dean Pound does not altogether agree; and yet, speaking from the point of view of a librarian, speaking particularly from the point of view of the Librarian of Congress, that seems to me to be the essential and primary problem for solution.

Dr. Wilbur: Do you think the library is going to be important in the future university, now that the microfilm has come in and they wrap things up in small packages and put them away in dark cellars?

Mr. MacLeish: I haven't thought that the size of the package made very much difference in the nature of the problem. It hasn't done anything more to us than complicate our problems.

Dr. Wilbur: Well, is there a way to make the library accessible without having a card catalogue, with a man to run the card catalogue, and a man to run him, and a lady to run the third one? [*Laughter*]

Mr. MacLeish: Well, Dr. Wilbur, you have perfectly stated our problem in the Library of Congress, where the main machine by which we make the collection available is a machine now so complicated that it has to have another machine to run it and that machine has to have someone to run it.

Dr. Wilbur: Where's the undergraduate student going to get off with that combination? Who's going to help him?

Mr. MacLeish: Fortunately, the undergraduate student doesn't—he goes to the public library in the District. We haven't him to worry about. If we had, I think we'd close up shop.

Dr. Wilbur: We have a good many such problems where the books are used, and our great difficulty is to know how, out of this great mass of material, the university and its teachers are going to select those books that are most important. Is there any way we can do that?

Mr. MacLeish: The only suggestion I can make—and certainly I can't make a suggestion from the point of view of the university—the only suggestion I can make from the point of view of a library like the Library of Congress is that there must be the positive intervention of scholars able to make, and willing to make, selections with reference to value judgments. That is, it is no longer possible simply to collect everything that has been published and represent it by cards in the catalogue and wait for the public to come in.

Dr. Wilbur: In other words, you look on the university faculty as in a position to be of great service to the one who wants to go further into any question, since he already is informed?

Mr. MacLeish: I should say the university faculty now oc-

cupies a position of infinitely greater importance than it ever has before simply by virtue of the complication of the problem.

Dr. Wilbur: Is there any way to keep up to date in a library, so that it can look forward instead of looking backward?

Mr. MacLeish: Ah, if a library could look forward!

Dr. Wilbur: There's no way to tell, is there?

Mr. MacLeish: I don't see how you can, if by looking forward you mean the direction of the purchasing of a library, so that a library anticipates the direction of social development. There I should say that, without the aid of the highest degree of scholarship and philosophical wisdom, a librarian is lost; and where you're to find that in relation to a library I don't know. There the university library has an enormous advantage, because in the university scholar it may find just such assistance.

Dr. Wilbur: Are there books that a student can read today that are going to be useful to him ten years from today?

Mr. MacLeish: Why not? I should think Dean Pound would say that there were books far back of today which are useful for a period far ahead of today.

Dr. Wilbur: Are there more than a hundred such books?
[Laughter]

Mr. MacLeish: Now, that question I pass to my learned teacher.

Dr. Wilbur: Do you want to pick that up for a minute, Dean Pound?

Dean Pound: Oh, I think there are more than a hundred such books. Of course, we have President Eliot's bookshelf. It has some things on it that seem to have proved worth while for a very long time; but there are shades and differences of value. As William James said, there are no differences but differences of degree between different degrees of difference and no difference. You can get endless gradation of importance in books,

and books that don't seem important at the time, a hundred years later sometimes come into a very considerable importance. I suppose you literary people would think of Melville there, wouldn't you, who was ignored at the time and came into great vogue a long time afterwards? In other words, you can't be sure about this matter of importance. As Mr. Hubble told us the other morning, value judgments are very relative things, and judgment that's pronounced absolutely may be very good for a little while and not very good a little while later. I should hate to limit the number to a hundred.

Dr. Wilbur: Is there any way, Mr. Hubble, to determine the value of a scientific book?

Mr. Hubble: The value of a scientific book—no, that would depend upon the definition of value, that is, distinguishing the knowledge from the wisdom included in the book. I wouldn't know how to judge the value of a scientific book except in terms of the end toward which it is directed.

Dean Pound: Darwin's *Origin of Species* was a very valuable book long after it was written.

Mr. Hubble: That is true, and books by the Greeks were of enormous value even in the field of science.

Dr. Wilbur: Is a book a point of view or a collection of facts?

Mr. Hubble: It is generally both.

Dr. Wilbur: When a university professor prepares a book after a series of researches, what is that book, authority, Dean Pound, or is it a suggestion?

Dean Pound: It might be both. It might be an authority for a time and a suggestion for time to come. Of course, one of the difficulties in almost any subject is that it is haunted by the ghosts of departed masters. Their methods that were valuable are forgotten and their authoritative statements are over-authoritative, but I should say both those elements have to be taken into account.

Dr. Wilbur: One of the functions of the university is to tap the various resources of knowledge. How are you going to tap the libraries?

Dean Pound: I have always felt about that—it depends on who's doing the tapping and what he's tapping for, and is a very hard thing to predict. As I said a moment ago, the only case I know of where anybody ever found the thing he wasn't looking for, was when Saul went out to look for his father's asses and found a kingdom. Except for that more-or-less miracle, people find things because they're looking for them and you can't tell what they'll be looking for and for what purpose. A big library is a good thing.

Dr. Wilbur: What do you think about that, Mr. Hubble, from the standpoint of a group of scholars working on a topic? Is that a more valuable procedure than a group of past-scholars represented in the library?

Mr. Hubble: I think a problem should always be studied with a sense of the past in mind, so that you would have a library always; and it is an excellent institution and an excellent organization that has a group of scholars working side by side on the same problem—same group of problems.

Dr. Wilbur: Isn't it true that the most important thing that we have in a university is a group of scholars and a group of students? The group of scholars pool their knowledge on the one side, and the group of students try to find through this group of scholars the avenues that they can use either to become scholars or to become proficient in some particular field?

Mr. Hubble: That, I dare say, is the art of teaching, which is quite distinct from the art of research.

Dean Pound: Yet the two are pretty closely connected, aren't they?

Mr. Hubble: We would like to have them even more closely connected than they are at present.

Dean Pound: It seems to me, while you can have the man who does pure research and the man who does nothing but teach, the effective man is likely to be the man whose research grows out of what he is made conscious of through his teaching and whose teaching develops what he has learned through his research.

Mr. Hubble: I think the great research men always stir the imaginations of those around them. I am not sure whether it is necessary that a great teacher should be a research man.

Dean Pound: Perhaps not necessary to teaching, and yet, on the other hand, isn't his teaching much more effective if what he gets he gets at first hand and not at second? I think of William James' saying that the worst enemies of any subject are the professors thereof, because, I take it, they're not in first-hand touch with the things that they deal with so often but build their theories on someone else, and perhaps see those things through spectacles that are somewhat astigmatic.

Mr. Hubble: I wouldn't know what to say to that except that great research men are rare and their energies should not be too greatly diverted from the tasks they have at hand.

Dean Pound: Too greatly—of course, I would accept.

Dr. Wilbur: But a great research man should have some disciples working with him, should he not, in group research, and isn't that a form of teaching? The highest form of teaching, in fact?

Mr. Hubble: As a matter of fact, that is teaching the teachers, if you wish.

Dean Pound: In that case they come in pretty close connection with firsthand information that they've got to build on.

Mr. Hubble: But their greatest contribution is that personal inspiration they transmit to a group of scholars around them.

Dr. Wilbur: I've been impressed in studying the plans that have come in for various research studies more and more that a

group of scholars gets back of a certain procedure. They find they need more and more information along lines of such personal inspiration in handling an intricate, complicated problem.

Dean Pound: And they correct each other's personal idiosyncrasies, which is an important thing. After all, professors are human beings.

Dr. Wilbur: I'm surprised that you'd mention that professors are human.

Dean Pound: I've never had any reason to believe that they were inhuman. What I mean is, of course, that anyone who devotes himself to some particular point is apt to give that particular point, especially if it's highly specialized, a rather exaggerated importance; and the man working next to him who has worked on some other point and sees that as the most important thing in the universe has a correcting influence. The two working together will often correct each other.

Dr. Wilbur: Isn't anything well taught by a good professor—good teacher—well worth while for the young?

Dean Pound: I think so.

Mr. Hubble: I'd agree with you on that, for the essence of teaching the young is disciplinary training, establishing habits of thought rather than the particular subject that is operated upon.

Dean Pound: The trouble is, a particular subject is apt to be like the encyclopedias of law we get out which say, "The law in this book is stated as of the 18th day of June, 1941," and then, of course, on the 19th day, perhaps, it's out of date. One of my colleagues calls his course "Current Events" on that theory. Now, teaching, of course, is the great corrective of that sort of thing.

Dr. Wilbur: As a matter of fact, you've worked in a domain, Dean Pound, where you've sought to bring order into a rather disorderly world, and you, Mr. Hubble, have been working in the domain of the stars where disorders show up as comets and

that sort of thing. The thing I've been impressed by is the orderliness of the real world when we discover it, either in science or in any other field.

Mr. Hubble: That is the working hypothesis of all scientific research. We use that working hypothesis and are pushing it to see how far it will go.

Dean Pound: Isn't that more a working hypothesis also in the social sciences than it's fashionable today to admit? Haven't we got experience there that is just as valid as phenomena as the phenomena of the physicists and the chemists?

Dr. Wilbur: I think we have, but the difficulty there is that we run into a thing called opinions and another thing called prejudices and another thing called politics.

Dean Pound: The natural sciences, you know, the physical sciences, as Galileo found out, can run up against prejudices and opinions.

Dr. Hubble: That was outside the field of science, Dean Pound.

Dean Pound: Yes, of course, today it's fashionable to call everything a science as a generation ago it was fashionable to call it a philosophy; but I can't help feeling that there's something in the idea of calling them the philosophies and something in calling them the sciences, because, after all, we've got a body of phenomena that have been established in experience about these things that we say are matters of opinion. We've got people who have an opinion that the earth's flat, but we don't pay any attention to that; and we've got people that have an opinion that it's perfectly impossible to have an objective and impartial judgment, that every man is governed by the Freudian wish down at the bottom of his constitution. But my suspicion is that we've not much more ground for the one than for the other; but we can establish certain things that have been demonstrated by experience in the history of civilization that are perfectly verifiable. And I don't claim that they're

ultimates, but I don't suppose you claim that anything that's discovered in astronomy is necessarily an ultimate. But it does very well for the time being until you have discovered more.

Mr. Hubble: That's correct. We deal with probabilities. We work on phenomena and our data are never precise.

Dean Pound: Isn't that what's complained about in the social sciences, that our data are never precise and we're dealing with sometimes a high degree of probability?

Mr. Hubble: No, sir. I think that in the social sciences human desires necessarily enter into the data themselves. Human desires are outside science.

Dean Pound: Isn't it rather that the human desires are things that we're dealing with, endeavoring to subject to some order of reasoning, and the desires are just like some of the unruly elements that the chemist has to deal with? They're a bit unruly, but he finds out what to do with them. We have these desires that we have to harmonize and integrate as well as we can; and the means of integrating them that have been proved by experience are just as real as the means that you find of discovering the relations between your physical phenomena.

Mr. Hubble: I'm not sure I agree with you, Dean Pound, on that.

Dean Pound: I don't expect you to. [*Laughter*]

Mr. Hubble: There's no impersonal court of appeals, in other words, to which men of all races and all religions can—

Dean Pound: Oh, that's perfectly true, but it is also true that there are certain things that have been so demonstrated in the history of civilization that you get a sufficiently general agreement for practical purposes.

Mr. Hubble: You do the best you can.

Dean Pound: Isn't that what you said you did in astronomy? You reach the best opinion you can?

Dr. Wilbur: —under the law of probability?

Dean Pound: Yes.

Mr. Hubble: That is true, but we have a court of appeals through the medium of which it's possible to get universal agreement on the subject matter.

Dean Pound: But in human desires that is not the case?

Dr. Wilbur: We have to get answers, whether they're good ones or not, and we do get them right along in the form of legislation and in the form of personalities with power. The question in my mind is—I see that Dean Pound senses a sort of orderly possibility in our human and social relationships based upon experience, perhaps upon psychology—is there in the university or in some of these processes hope that we can bring about a sense of responsibility on the part of the individual that will give us the opportunity to preserve our democracy?

Dean Pound: That's exactly what I was driving at and what I was saying, that in all we say about democracy we put the stress upon power; but correlative to power is always responsibility, and the great function of our university seems to me to be exactly that, to bring out that responsibility element and make it something with some more foundation than just a feeling of my personal opinion or of bringing up or prejudice—of what ought to be done or what ought not.

Dr. Wilbur: An understanding loyalty, so that it's used to do something that counts rather than simply blind following.

Dean Pound: Exactly.

Dr. Wilbur: Isn't that one of our great functions in the university?

Mr. Hubble: Without question. Learn to distinguish between knowledge and wisdom.

Dr. Wilbur: Now, when you come to the question of training men so that they'll get a sense of responsibility, can they get it better from a diffuse study of a series of subjects or from very penetrating studies of a single subject?

Dean Pound: Oh, I think Mr. Hubble and I will agree this time that it's got to be a penetrating study of a few things.

Dr. Wilbur: In other words, a penetrating study of one or more things gives one a better opportunity to understand something that may be unknown to him?

Dean Pound: It gives him method, which is a very important thing.

Dr. Wilbur: You're not, then, very much in favor of the wisecracking student and professor?

Dean Pound: No, the wisecracker is my *bête noire*—what I call soph-Alexandrics is what I object to.

Dr. Wilbur: They're not answers, at any rate.

Dean Pound: No, they don't lead to anything except amusement.

Dr. Wilbur: I judge, then, that there is a good deal of confidence in your mind that we can work out these social sciences, that your long experience in attempting to bring about order through law and procedures has made you feel that along those lines we are making progress and will make more.

Dean Pound: I wouldn't want to put it simply on my relatively short experience. The fact that the jurisconsults at the time of Augustus worked out certain things as solutions of difficult problems of adjusting human relations that still govern half the world today seems to me a pretty good answer. They may have been just the opinions of those jurisconsults, but those opinions have been thoroughly workable instruments of justice for centuries.

Dr. Wilbur: Do you read the old books in the library on things that come up before you each day?

Dean Pound: Oh, you have to at times and not at others. It's perfectly true that you can't find an answer to everything in the *Digests* of Justinian or in Coke's *Second Institute*, but the fact that our bills of rights were taken out of Coke's *Second Institute*, after all, means a good deal.

Dr. Wilbur: Mr. Hubble, what is the significance of mathematics in the field of human living?

Mr. Hubble: Mathematics deals with possible worlds, that is, with logically consistent systems. We live in one particular world. Science, I might add, is an attempt to discover which particular world that is.

Dr. Wilbur: You use mathematics in your world of probabilities. Can we use mathematics safely in our field of actualities?

Mr. Hubble: You can use it to deduce conclusions from a given set of axioms, but it has no bearing whatever on the validity of the axioms.

Dr. Wilbur: I was interested in what Dean Pound said about philosophy and his definition of it. Is there any mathematics in philosophy, or any philosophy in mathematics?

Mr. Hubble: In so far as mathematics is or may be logic, mathematics or logic would be the very essence of philosophy.

Dr. Wilbur: Dean Pound, have you anything to say on that?

Dean Pound: Of course, that depends on what you mean by philosophy. If you mean what Spencer did, the unification of knowledge, I don't know. But, of course, today, a logical relativism, I suppose, is what stands for philosophy. It's a matter of definition.

Mr. Hubble: The difference between induction and deduction, I have found.

Dr. Wilbur: Thank you very much, Dean Pound and Mr. Hubble, for your contributions. As I see this whole program which we have been discussing here, "The University and the Future of America," we have outlined through these various symposium speakers some of the problems of the university, some of the possibilities of the university. And I think a number of the speakers have endeavored to carry over into our common living what can be done by the university in making this a better world in which to live. I get out of this that there is an orderly world, that we can become orderly ourselves if we learn how to depend upon that, that if we keep in the domain of

superstition and prejudice, perhaps of religion, and dodge the world that the university knows, we may fall far short of our possibilities. I think the point made by Dean Pound on responsibility and responsible citizenship is the key to this whole question. We want to train in the university men of very diverse capacities in various fields and train them with a sense of responsibility so that they can make the university count in the wide domain that is opening to us in our advancing civilization. And we here at Stanford feel that we've made some contribution by bringing together this group of scholars and letting them tell us something of the university and more of the hopes for America.

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Ladies and gentlemen, you have been listening to a forum discussion at Stanford University on "The University and the Future." Those participating were: President Ray Lyman Wilbur of Stanford University; Dr. Edwin P. Hubble, astronomer at the Mount Wilson Observatory; Archibald MacLeish, Librarian of Congress; and Professor Roscoe Pound of Harvard University. This forum is one of the concluding parts of the four days' symposium on the occasion of Stanford University's celebration of its first fifty years.

Tomorrow, commemoration week will end with the formal exercises in which sixty-five university and college presidents will participate and with a formal dedication of the new building of the Hoover Library on War, Revolution, and Peace which has just been erected on the Stanford campus to house the world's greatest collection of documents on the World War and its aftermath.

This program came to you from Memorial Hall on the campus of Stanford University at Palo Alto, California, as another public-service feature of NBC and the independent radio stations associated with the blue network of the National Broadcasting Company.

Résumé

HERBERT HOOVER



THERE has been held here a symposium upon "The University and the Future of America." This is a discussion worthy of the celebration of the Fiftieth Anniversary of a great University. That subject has been here dealt with by national leaders in Education, in History, in the Law, in Science, in Economics, Sociology, Government, and in Philosophy. Within this discussion run not alone a remarkable contribution to the future of university service but beyond that a remarkable exposition of the forces now in the making of the world at large. Indeed there could be no adequate discussion of "the university and the future of America" without consideration of the future of the world itself.

And this symposium comes at no ordinary time. For there is a recognition by all these eminent men of changes in the forms of life and living that hang in great portent over civilization.

Originally I was asked to summarize this symposium. I, however, begged off that task because I felt that I could not do justice to it. That feeling was one of inadequacy. Then I was put down for a subject "to be announced." I do not have a subject. In my present preoccupations with questions of war and peace and of starving and dying millions of people, I move in a field apart from the necessary atmosphere of these long-view discussions.

I could of course talk at length upon the achievements of Stanford over this past fifty years. I could speak of the great leadership of its three Presidents, Jordan, Branner, and Wilbur.

As I was one of the first students here I could talk upon the great teachers who have left their imprint upon thousands of Americans. I could talk upon the contribution of the University to science, to literature, to humanity, and to government. I could even discuss the achievements of Stanford men and women in every part of the world and in every walk of life. Yet others will do that better than I can.

Searching for a short subject I have read these remarkable papers of this symposium all over again. I got not one subject but a thousand. But the trouble is they know more about their subjects and can say more about them than I could ever hope to. Your speakers have ventured on prophecy but little. It is much easier to debate with a prophet than an expert. They have indicated the nature of the many forces in motion, in the nation and the world. Some are good and some evil. And I might add that these impending changes in the form of things would be difficult enough for humanity to compass constructively in peace, but in the midst of a destructive world war they become doubly difficult.

I suspect that these great addresses are in reality the voices of the university world directed to the layman. So I will employ myself with a few words from a layman to the university world. To lead the forces discussed here to the good of the nation the universities must take a large part. They now have certain outstanding responsibilities beyond their major purpose of the training of our youth.

First: The whole growth of university life, its whole contribution to civilization, thrives only in the air of freedom of mind and of spirit. Without that stimulant to creative thought, without that privilege to adventure into doubt, without that freedom from repression and terror, all expansion in ideas must shrink, the critical function must wither, and all but the dry ashes of education are gone. The first obligation of our univer-

sities to the future of America is to fight every impairment of intellectual and spiritual liberty. With the infection of war psychosis breaking out over the land the fight is not far away.

Second: The universities must be the insistent guardians of truth and of intellectual honesty. And in this world, sodden with propaganda and demagoguery, they are our great hope. I know the philosophic view that truth is only proximate; that people differ on what constitutes truth. But, despite even hair-splitting, there are enough standards of truth at any one period to lead men and women away from error. Moreover, the last war and the events which have followed have demonstrated that free minds and free spirits cannot survive if the people are to be corrupted by even half-truth. The roads to totalitarianism are bordered with wreckage of truth. And I may add that the road to foreign wars is lighted with propaganda which is itself half-lies and quarter-truths. The future of America depends upon our people reaching their own conclusions unclouded by such poison.

Third: The widening of the boundaries of knowledge must come largely from our universities. It is here where knowledge can be expanded for knowledge's sake. It is here where men are not driven to produce and buy and sell. It is here where human experience and history must be constantly re-distilled for the problems of each generation. It is here where research in pure social and physical sciences must largely be carried on. It is here where constantly added knowledge, cell by cell, fact upon fact, can bring forth the blossoms of discovery, of illuminating hypothesis, of fundamental law and the great generalizations. They are the raw materials of invention, of new method, of increasing human security and comfort.

Fourth: Obviously the basis of all education is instruction in accumulated knowledge and in human experience. This is the place where the past is connected to the present. In times

of great change humanity seems often determined to discard all the lessons from the long upward toil of mankind. In its miseries and its gropings for some easy way out, it demands something arbitrarily new. The very slogans of our times are evidence of it. We hear hourly of the "New Day," the "New Freedom," the "New Education," the "New Era," the "New Deal" and the "New Order." Sometimes I could wish desperately for a substitute for that word "new." It has come to connote break with all knowledge and experience and to do it violently. If the word "progressive" or "advancing" could be substituted for it I should have more hope for usefulness of slogans. That would connote a building upon the past of human experience. It would connote forward movement; it would connote stability instead of violence. I could get up many enthusiasms for slogans of the "progressive day," the "advancing freedom" and the "progressive order." When the sun rises in the morning we hail it as the new day. We cheer at the passing of the night. But it is a false analogy in the march of civilization. Our chores for the next day are assigned the day before. Our abilities to perform them were formulated not even the day before but centuries and even in geologic time before. If it were a day without the link of yesterday and indeed the link of the last million years it would be chaos. Even chaos might not be new. In any event, whatever the use of words may be, the function of the university is to stand for orderly progress, for evolution, not the revolution of violence.

Fifth: The universities must hold up the standards of ethics and the great domain of ideal values. They must constantly reformulate them to meet the changing evils which rise with a changing world. Their clear voice of right and wrong and justice must sound out above the clamor of conflict and confusion in times of crisis. The universities can be centers from which fear and hate generated of these conflicts and confusions

may be allayed. They can be the centers from which compassion upon the suffering can be demanded. They can be the place from which the immoralities of arrogance in officials can be reprimanded. The universities can uphold the dignity of the individual man and woman as the whole basis of human progress.

Sixth: The universities can give guidance to constructive forces in time of crisis and they can check destructive forces. Among these forces are issues of peace and war. I am not discussing pacifism or militarism. Nations must defend themselves from military conquest. But war is the greatest destroyer of civilization. The universities should sit in judgment upon those who claim the need of war. With their knowledge of history, their knowledge of the causes of war, they can expose the aggressor; they can expose provocative action; they can hold up truth against propaganda; they can allay fear; they can call to a people to stop, look, and listen. They can apply the weights of objectivity and experience to the arguments of the fanatic and the foolish. They can and must oppose that submergence of freedom of speech and press which comes with the madness of war psychosis.

All these six functions which bear upon the future of America may yet require a heroic stand on the part of the universities. With two-thirds of humanity in desperate war, with the remainder arming to the teeth, with vast problems imposed upon us by our own discoveries in science, with the recognition of a greater obligation of man to his neighbor, the world is indeed of troubled mind, of conflict, and of confusion.

There have been confusions and periods of change before now. Civilization has survived these confusions and even grown out of them greater in soul, in freedom, and in safety. But how? Because of some men and some institutions who stood fast. They stood not because they knew the solution to all these confusions

and changes, not even because they had the power to find solutions. They held to certain positive principles of life, of morals, and of spiritual values. They stood firm and they held the lights of civilization until the furies passed.

There have been universities which held these lamps aloft in darkness before now. They will be needed in the days to come. They are needed right now. And there have been universities which have failed and gone into eclipse.

After all, the constructive progress of civilization is not founded on power of men over matter. It is founded upon the advance of truth, of knowledge, of beauty, and of obligation to fellow men. These are the fields of the free spirits and they are the fields of our universities.

There is one phase of this address which I wish to emphasize even further. That is free men and women. In the changes with which the world is faced, many of our speakers have properly forecast the growth of governmental domination in the life of the people. It means more limitations on personal liberty. That is inevitable even in the democracies. It is inevitable from the growing complexity of national life. It will come faster under the necessities of preparedness. And government may submerge all liberty in case of war. Then it is the universities which must raise again the lamp of freedom.

To me, there is one test of all these proposals of further governmental encroachments upon the lives of men: "Does this or that act increase or protect or does it limit or destroy intellectual or spiritual freedom? Does it make for the dignity of all men?" The whole progress of mankind depends upon that chart. It is the only convoy of American civilization.

Two or three hundred years ago the world began again after centuries of the Middle Ages to shake off the bonds from free minds and of free spirits. Our nation was born under these stars. We might call it the resurrection of personal liberty. From this

very release of mind and spirit sprang our great scientific discoveries and their application in invention and machines and methods of production. And thus we built up what is sometimes called industrial revolution. But out of this very industrial revolution and all its growth of productivity and wealth we created a thousand limitations of personal liberty, a thousand dominations of men. Every scientific discovery, every new invention, produced new possibilities of privilege as well as progress.

And then began a conflict which we have sought to solve. Indeed, freedom is the most difficult of all philosophies to realize in government because the very freedom which vitalizes the soil of progress sprouts also the weeds of selfishness and sordid ambition and untruth. The most easily available instrument for the protection of freedom is government. We use it too freely. For over seventy years we have been ceaselessly legislating, ceaselessly trying by trial and error to find solution to these conflicts. Too often the real test of intellectual freedom and intellectual integrity has not been searchingly applied to these doings.

And now across these complexities of our own comes war in the world. And intellectual and spiritual freedom are even in worse jeopardy. There is another phase of this symposium which interested me profoundly. That was the constant urge for a better synthesis of the facts and experiences of these many specialties in knowledge and the presentation of their probable combined consequences. That would be important to public guidance and high statesmanship. It would help if the law, sociology, economics, and history could get together and define where the enlargement of government begins to crowd the freedom of mind and spirit. That would be helpful. I have some worry over what the politicians would do with a synthesis, but we will let that pass. I have wished that the economists and the sociologists and the governmentalists generally would get together with the biologists. In the long run, society will be built

upon the sums of human behavior. And that behavior has deeper roots than wishful thinking and exhortation. Those chromosomes which transmit the behavior of geologic ages ought to haunt at least part of the thinking of the social and governmental doctors. This human animal has certain inheritances that cannot be wholly shaken off. From these chromosomes he gets certain pretty fixed instincts and determinates. He is an acquisitive animal. Just like the squirrel, from his chromosomes, man will put up nuts for the winter. If we want to motivate him to effort he must be allowed to keep some nuts. He also gets a love of power with his chromosomes. And among his chromosomes seem to be some which yearn for some mystical basis of organization which would yield him the highest values of the spirit and at the same time pay his food bills.

Man is apparently also born with a chromosome that urges him to organize—to organize the gang or the tribe or the nation to gain power by his own elevation or power for his group by which he will benefit. If we want to implement his mental energies we probably have to allow this chromosome some opportunities for exercise. There is an inborn limit to what exertion he will make solely for the collective good. And it is upon this chromosome that some of the current solutions for our complexities will be wrecked.

Generally these chromosomes seem to form a heavy nucleus of behavior around which there revolve some electrons of altruism. The job of the university is to excite the activities of these electrons.

But again I wander into the troubles of our daily life and away from the purpose of these discussions. To me the sum of these great addresses is hope. It is hope founded upon evidence of constructive minds. They are minds reaching into the past and projecting into the future for solutions to the perplexing problems of humanity. And that hope warrants a faith in the university and the future of America.

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